उत्तर प्रदेश प्राविधिक विश्वविद्यालय, लखनऊ, भारत

Uttar Pradesh Technical University, Lucknow, India

Syllabus M.Pharm (Pharmaceutical Chemistry)

STUDY AND EVALUATION SCHEME

Course: M. Pharm. (Pharmaceutical Chemistry) Effective From Session 2008 – 09

Semester-I

Sl. No	Course Code	Subject	Period (hours/week)		IA		ESE		Subject Total
		Theory	T	P	T	P	T	P	
1	PHAR 511	Modern Analytical Technique	4	-	30	-	70	-	100
2	PHAR 512	Pharmaceutical Biostatistics & Computer Application	4	-	30	-	70	-	100
3	PHAR 514	Drug Regulatory Affairs & Intellectual Property Rights	4	-	30	-	70	-	100
4	PHAR 516	Advanced Organic Chemistry	4	-	30	-	70	-	100
5	PHAR 518	Drug Design	4	-	30	-	70	-	100
Practical								Day to Day Evaluation	
6	PHAR 511P	Modern Analytical Technique		6		30	-	70	100
7	PHAR 516P	Advanced organic Chemistry		6		30	-	70	100
								Total	700

T-Theory, P-Practical, IA-Internal Assesment, ESE-End Semester Examination
Note: Duration of ESE –Theory exam is of 3 hours and Practical exam is of 6 Hours.

STUDY AND EVALUATION SCHEME

Course: M. Pharm. (Pharmaceutical Chemistry) Effective From Session 2008 – 09
Semester-II

Sl. No	Course Code	Subject	Period (hours/week)		IA		ESE		Subject Total
		Theory	T	P	T	P	T	P	
1	PHAR 526	Advanced Medicinal Chemistry	4	-	30	-	70	-	100
2	PHAR 527	Natural Products	4	-	30	-	70	-	100
3	PHAR 528	Polymers and Bio-organic Chemistry	4	-	30	-	70	-	100
4	PHAR 525	Synopsis of the proposed dissertation and Viva-voce		8					100
Practical								Day to Day Evaluation	
6	PHAR 526P	Advanced Medicinal Chemistry	-	6	-	30	-	70	100
7	PHAR 528P	Polymers and Bio-organic Chemistry	-	6	-	30	-	70	100
							Total		**600**

T- Theory, P- Practical, IA- Internal Assessment, ESE- End Semester Examination
Note: Duration of ESE- Theory exam is 3 hours and Practical exam is 6 hours.

STUDY AND EVALUATION SCHEME

Course: M.Pharm (Pharmaceutical Chemistry) **Semester-III& IV**

Sl. No	Course Code	Subject	Period (hours/week)		IA		ESE		Subject Total
		Theory	T	P	T	P	T	P	
1	PHAR 611	Dissertation							300
2	PHAR 612	Presentation & Viva Voce							200
								Total	**500**

M. Pharm (Pharmaceutical Chemistry)
(First Semester)

PHAR-511 Modern Analytical Techniques

Unit - 1

UV-Visible Spectroscopy: Principle of UV-Visible Spectroscopy, Chromophores and their interaction with UV-visible radiation and their utilization in structural, qualitative and quantitative analysis of drug molecules. Woodward-Fieser rule, use of shiff reagents for elucidation of structures. Fundamentals of Optical Rotatory Dispersion. Cotton effect curves, octant rule, circular dichronism.

Unit - 2

Infrared Spectroscopy: Infrared radiation and its interaction with organic molecules, vibrational mode of bonds, instrumentation and applications, effect of hydrogen bonding and conjugation on absorption bands, interpretation of IR spectra. FTIR and ATR, X-ray diffraction methods.

Unit - 3

Nuclear magnetic resonance spectroscopy: Magnetic properties of nuclei, field and precession, chemical shift concept, isotopic nuclei, reference standards and solvents. ^{1}H NMR spectra, chemical shifts, multiplicity, coupling constants, integration of signals, interpretation of spectra, decoupling-double resonance and shift reagent methods.

Principles of FT-NMR with reference to ^{13}C NMR, free induction decay, average time domain and frequency domain signals. Spin-spin and spin-lattice relaxation phenomenon. Protein noise decoupled spectra. Nuclear overhauser enhanced ^{13}C NMR spectra, their interpretation and application. APT and DEPT techniques. Introduction of 2D NMR techniques, COSY, with application.

Unit - 4

Mass spectrometry: Basic principles and brief outline of instrumentation. Ion formation, molecular ion, metastable ion, fragmentation process in relation to molecular structure and functional groups. Relative abundance of isotopes, chemical ionization, FAB, ESI, Maldy, GC-MS and other recent advances in mass spectrometry.

Unit - 5

Chromatographic techniques: Principles of separation and application of Column, Paper, Thin layer and Gas chromatography, HPLC, HPTLC, Size exclusion chromatography, Affinity chromatography, Electrophoresis. Instrumentation of HPLC, Preparative and micropore columns, Reverse phase columns, Mobile phase selection and detectors in HPLC. Instrumentation and application of DCCC.

Biological standardization: Bioassay & Radioimmunoassay: ELISA, Radioimmunoassay of drugs like Digitalis & Insulin

PHAR-511 P Modern Analytical Techniques

Practicals based on theory syllabus.

Books Recommended:

1. Willard, H.H., Merrit, L.L., Dean, J.A., Settle P.A., Instrumental Methods of Analysis, Van Nostrand.
2. Skoog, D.A., Heller, F.J., Nieman, T.A., Principles of Instrumental Analysis, WB Saunders.
3. Hunson, J.W., ed. Pharmaceutical Analysis, Modern Methods, part A & B, Marcel Dekker.
4. Schirmer, R.E., ed. Modern Methods of Pharmaceutical Analysis, Vols 1, 2. Boca Raton F.L., CRC Press.
5. Mann, C.K., et al., Instrumental Analysis Harper & Row.
6. Jaffe, H.H., Orchin M., Theory & Applications of Ultraviolet Spectroscopy, Willy.
7. Silverstein, Spectrometric identification of Organic Compounds, Willy.
8. Bovey, F., Jelinski, L., Miran, P., Nuclear Magnetic Resonance Spectroscopy, Sau: Diego Academic.
9. Stothers, J.B., Carbon-13 NMR.Spectroscopy, Academic.
10. Gordy, W., Theory & Applications of Electron Spin Resonance, Willy.
11. Haswell, S.J., ed. Atomic Absorption Spectroscopy, Elsevier.
12. Ardrey, R.E., Pharmaceutical Mass Spectra, Pharmaceutical Press, London.
13. Budzikiewicz, et al., Interpretation of Mass Spectra of Organic Compounds, Holden-Day San Francisco.
14. Beckett and Stenlake, Practical Pharmaceutical Chemistry, CBS.
15. Stahl, E., Thin Layer Chromatography- A laboratory Handbook, Springer-Verlag
16. Giddings, J.C., Principles and Theory- Dynamics of Chromatography, Marcel Dekker.
17. Sethi, P.D., Quantitative Analysis of Pharmaceutical formulations, CBS Publishers, New Delhi.
18. Kemp William, Organic spectroscopy, Pal grave, New York.
19. Kalsi, P.S., Spectroscopy of organic compounds, New age publishers, New Delhi.
20. Gross - Mass Spectrometry
21. WHO - Quality Assurance of Pharmaceuticals, Vol. I, II.
22. Sethi, P.D., HPLC, Quantitative Analysis of Pharmaceutical Formulations, CBS Publishers, Delhi.
23. Sethi, P.D., HPTLC, Quantitative Analysis of Pharmaceutical Formulations, CBS Publishers, Delhi.
24. Haffmann, Chromatography.
25. Sethi and Charcgankar, Identification of Drugs in Pharmaceutical Formulations by TLC.
26. Robert D. Braun, Introduction to Instrumental Analysis.
27. Wilfried, M.A. Niessen- Liquid Chromatography-Mass Spectrometry.
28. Harry G. Brittain, Spectroscopy of Pharmaceutical Solids.
29. George, S., Steroid Analysis in Pharmaceutical Industry.

30. Higuchi, Pharmaceutical Analysis.
31. Bidingmeyer, Practical HPLC Methodology and Applications.
32. Hoffmann, Mass Spectrometry: Principle and Application.
33. Scott, Techniques and Practice of Chromatography.
34. Wilkins, Identification of Microorganism by Mass Spectrometry.
35. Wu, Handbook for Size Exclusion Chromatography and related Techniques.

PHAR-512 Pharmaceutical Biostatistics and Computer Applications

Unit - 1

Methods of collection of data, classifications and graphical representation of data. Binomial and normal probability distribution. Polygon, histogram, measure of central tendency. Significance of statistical methods, probability, degree of freedom, measures of variation - Standard deviation, Standard error.

Unit - 2

Sampling, sample size and power. Statistical inference and hypothesis. Tests for statistical significance: student t-test ,Chi-square test, confidence level, Null hypothesis.

Unit - 3

Linear regression and correlation. Analysis of Variance (one way and two way). Factorial designs (including fraction factorial design). Theory of probability, Permutation and Combination , Ratios, Percentage and Proportion. Two way ANOVA and Multiple comparison procedures.

Unit - 4

Non-parametric tests, Experimental design in clinical trials, Statistical quality control, Validation, Optimization techniques and Screening design. Correlation and regression, least square method, significance of coefficient of correlation, nonlinear regression.

Unit - 5

Bioassays-calculations of doses response relationships, LD_{50}, ED_{50}, probit analysis.
Applications of software for statistical calculation viz. SPSS, foxtron.
Application of computers in Pharmaceutical sciences.

Book Recommended:

1. Bolton, Pharmaceuticals Statistics- Practical & Clinical Applications, Marcel & Dekker, New York.
2. Fisher, R.A., Statistical Methods for Research Works, Oliver & Boyd, Edinburgh.
3. Chow, Statistical Design and Analysis of Stability Studies, Marcel Dekker, New York.
4. Buncher, Statistics in the Pharmaceutical Industry, Marcel Dekker, New York.
5. Finney, D.J., Statistical Methods in Biological Assays, Hafner, New York.
6. Montgomery, D.C., Introduction to Statistical Quality Control, Willy.
7. Khan, Irfan A., Biostatistics for Pharmacy.

8. Khan, Irfan, A., Fundamentals of Biostatistics.
9. Gauthaman, Biostatistics for Pharmacy students.
10. Lipschutz, Introduction to Probability and Statistics.
11. Liwan Po, Statistics for Pharmacist.
12. William E. Fassett, Computer Application in Pharmacy.
13. Ekins, S., Computer Application in Pharmaceutical Research & Development, Wiley.
14. Nageswara Rao and Tiwari, Biostatistics and Computer Applications.

PHAR-514 Drug Regulatory Affairs and Intellectual Property Rights

Unit - 1
Drug & Cosmetics Act with special reference to schedule Y and M, schedule of medical devices.

Unit - 2
Concept of total quality management, requirements of GMP, GLP, GCP, Regulatory requirements of drugs and Pharmaceutical (USFD-NDA/ ANDA)

Unit - 3
Documentation and Maintenance of records.

Unit - 4
Intellectual property rights patents, Trademarks, Copyrights, Patents Act.

Unit - 5
Environment protection Act, Pollution Control, Factories Act.

Books Recommended:

1. Willing, S.W., & Stoker, Good Manufacturing Practices for Pharmaceuticals, Marcel Dekker, New York.
2. Guarino, R.A., New Drug Approval Process, Marcel Dekker, New York.
3. Drug & Cosmetic Act.
4. Patents Act.
5. Consumer Protection Act.
6. Environmental Protection Act.
7. Federal Food, Drug & Cosmetic Act.
8. Bansol, IPR Guidelines for Pharm students and Researchers.
9. Pisano-FDA Regulatory Affairs.
10. Phillip W. Grubb, Patents for Chemicals, Pharmaceuticals and Biotechnology.

PHAR-516 **Advanced Organic Chemistry**

Unit-I

a. Aliphatic electrophilic substitution.
b. Aromatic electrophilic substitution.
c. Aliphatic nucleophilic substitution.
d. Aromatic nucleophilic substitution.

Unit-II

a. Free radical reactions.
b. Elimination reactions.
c. Addition to carbon-carbon multiple bonds.

Unit-III

Study of reactions of Synthetic importance:

a. Birch reduction.
b. Mannich reaction.
c. Diel's alder reaction.
d. Meerwin Pondroff-Verley reduction.
e. Oppeneaur oxidation.
f. Beckmann rearrangement.
g. Grignard reaction.
h. Hoffmann rerrangement.
i. Catalytic hydrogenation reactions.
j. Ozonolysis.
k. Reformatsky reaction.
l. Micheal reaction.

Unit-IV

a. Geometrical isomerism & Stereoechemistry of Allenes.
b. Optical rotation and Optical rotatory dispersion.
c. Uses of achiral and chiral heterogenous and homogenous catalysts.

Unit-V

a. Stereochemistry of five & six membered rings fused & bridged rings.

b. Stereoselective synthesis and stereoregulated polymerization.

PHAR- 516 P Advanced organic chemistry

Practical based on theory syllabus

Books Recommended

1.Eliel, E.L., Stereochemistry of Carbon compounds. MC.Graw Hill Book Company, Inc.
New York.

2. March, J., Advanced Organic Chemistry, Reaction Mechanism and Structure , John
Wiley and sons, New York.

3. Singh, H and Kapoor, V.K., Organic Pharmaceutical Chemistry, Vallabh Prakashan
Delhi.

4. Gould, E.S., Mechanism and structure in Organic Chemistry, Holt, Rinewart and Winston , New York.

5. Abraham D.J., ed.,Burger's Medicinal Chemistry & Drug Discovery, Vol.-I-VI,John
Wiley & sons, New Jersey.

6. Ford M.E., Catalysis of organic reactions, Marcel Dekker Inc., New York.

7. Laszlo Kurti, Barbara Czako, Strategic Applications of Name reaction in Organic Synthesis, Elsevier, Academic Press, New York.

PHAR-518 Drug Design

Unit-I

Introduction to Drug Design Concept, Lead Discovery Interactions (Forces) Involved in Drug-Receptor Complex, Physicochemical Properties in Relation to Biological Action, Stereochemical Aspects in Drug Design.

Unit-II

Drug metabolism- Phase-I & Phase-II Metabolic Reactions, Introduction to Drug Designing on the Basis of Metabolic Pathways.
Prodrugs- Bioprecursor & Carrier Linked Prodrugs, Hard and Soft Drugs.

Unit-III

Analog Based Drug Design-Introduction, Designing of Analogs.
Structure Based Drug Design- Introduction, Drug Design on Structure Based.

Unit-IV

Combinatorial Chemistry- Introduction , Solid Phase Synthesis, Liquid Phase Synthesis, Methods of Parallel and Mixed Combinatorial Synthesis, Deconvolution and High Throughput 0creening .

Unit-V

Molecular Modeling- Introduction to Molecular Mechanics, Quantum Mechanics, Molecular Dynamics, Molecular Graphics and Molecular Docking.

QSAR- Introduction, Tools & Techniques, Physicochemical Parameters, Quantitative Models , Introduction to 2D and 3D QSAR.

Books Recommended

1. Smith HJ, Williams H, eds, " Introduction to the principles of Drug Design" Wright Boston.
2. Silverman R.B. " The organic Chemistry of Drug Design and Drug Action" Academic Press New York.
3. Robert GCK,ed., " Drug Action at the Molecular Level" University Prak Press Baltimore.
4. Martin YC. " Quantitative Drug Design" Dekker, New York.
5. Lien EJ. SAR " Side effects and Drug Design" Dekker, New York.
6. William H, Malick JB " Drug Discovery and Dovelopment" Humana Press Clifton.
7. Delgado JN, Remers WA eds " Wilson & Gisvolds's Text Book of Organic Medicinal & Pharmaceutical Chemistry" Lippincott, New York.
8. Foye WO " Principles of Medicinal chemistry ' Lea & Febiger.
9. Koro lkovas A, Burckhalter JH. "Essentials of Medicinal Chemistry" Wiley Interscience.
10. Wolf ME, ed "The Basis of Medicinal Chemistry, Burger's Medicinal Chemistry" John Wiley & Sons, New York.
11. Ariens EJ " Drug Design" Academic Press New York.
12. Olson EC "Computer Assisted Drug Design" American Chemical Society ACS Symposium Series 112.
13. Roberts SM, Price B.J.Eds. " Medicinal Chemistry. The Role of Organic Chemistry in Drug Research " Academic Press New York.
14. Pope & Perruuns " Computer Aided Drug Design " Academic Press New York.
15. Thomas , G.Medicinal Chemistry-An Introduction John Wiley and sons Ltd.
16. Patrick Graham, L., An Introduction to Medicinal Chemistry, Oxford University Press.
17. Fischer Janos, Ganellin C. Robin "Analogue-based drug Discovery, Wiley-VCH Verlag Gmb H & Co. KG &A.
18. Pandi, Veerapandian "Structure based drug design New York Marcel Dekker, inc., 1997.
19. Wermuth GC, "The Practice of Medicinal Chemistry" Second edition, Academic Press, Elsevier

(Second Semester)

PHAR- 526 Advanced Medicinal Chemistry

Unit-I

Classification, mechanism of action,SAR, synthetic approach and recent advances of fourth generation cephalosporins and fluoroquinolone antibacterials.

Unit-II

Classification, mechanism of action, SAR, synthetic approach and recent advances of CNS depressant agents.

Unit-III

Classification, mechanism of action , SAR, synthetic approach and recent advances of-

a. Sex Harmones and corticosteroids.
b. Adrenergic agents.

Unit-IV

Classification, mechanism of action, synthetic approach & recent advances of-

a. Anti- HIV agents.
b. ACE inhibitors and statins

Unit-V

Classification, mechanism of action and recent advances of-

a. Drugs used in peptic ulcer.
b. COX-2 inhibitors
c. Artemisin derivatives
d. Macrolide and anti-cancer antibiotic.

Books Recommended

1. Foye W, “Principles of Medicinal Chemistry” Lea & Febiger.
2. Delgado J.N., Remers WA eds, “Wilson & Giswolds Text Book of organic Medicinal & Pharmaceutical chemistry” Lippincott, New York.
3. Monographs and relevant review articles appearing in various periodicals and journals.
4. Alex Gringauz-“ Introduction to Medicinal Chemistry” Wiley-VCH, Inc. New York.
5. Abraham DJ,ed., Burger’s Medicinal Chemistry & Drug Discovery, Vol-I-VI, John Wiley & sons, New Jersey.

PHAR-526 P Advanced Medicinal Chemistry

Practical Based on Theory syllabus

PHAR- 527 Natural Products

Unit-I

Role of Natural Products in new Drug Development, plant derived drugs , novel drug templates.

Unit-II

Bioactive compounds from micro-organism with reference to antibiotics, anti-protozoals and marine natural products.

Unit-III

Structural elucidation insights for natural products by combination of classical, synthetic, degradative and spectral methods with reference to quercetin, tropanes and morphinan type alkaloids, quinine, digitoxigenin, camphor and caffeine.

Unit-IV

Pharmacological Screening of Herbal Drugs- Introduction and evaluation of herbal drugs for antidiabetic, hepatoprotective, diuretic, anti-diarrhocal, antiulcer, wound healing, cardiovascular, anti-inflammatory,analgesic, antipyretic, antifertility, anti-oxidant, anti-viral & cyto-toxic properties.

Unit-V

Biomedicinals from plant tissue culture- Introduction, profile of plant tissue culture, bioproduction of commandable secondary metabolites, Hi-Tech products from plant sources with reference to Genistein, Comptophein, Rhein & Taxanes, Recombinant DNA technology.

Book Recommended

1. Trease and Evans, Pharmacognosy, 15th edition, Elsevier.
2. Burger's Medicinal Chemistry, 6th edition,Vol-I,Wiley Interscience, New York.
3. Chemistry of natural products by S.V.Bhat, B.A.Nagasampegi, Springer publications. New York.
4. Finar, Organic Chemistry, Vol-I

5. Drug Discovery and Evaluation, Pharmacological assays, H.Gerhard Vogel, 2nd edition, Springer publications,
6. Quality Control of Herbaldrugs, An approach to evaluation of botaniocals, by Pulok Mukherjee, Business Horizon Publications.
7. Pharmacognosy and Pharmacobiotechnology, by Ashutosh Kar, New age International publications.
8. Role of Biotechnology in Medicinal and Aromatic plants, Vol-XIII, Ukaaz Publications, Hyderabad.
9. Supplement to cultivation and utilization of medicinal plants, S.S.Handa and M.K.Kaul, RRL Jammu.
10. Chemistry of Natural Products, by O.P.Agarwal, Vol-I & II.

PHAR-528 Polymer and Bio-Organic Chemistry

Unit-I

Polymers- Classification, Synthesis, reactions, crystallinity, polymer degradation mechanism,copolymerization and their applications in Pharmacy.

Unit-II

Classification, Chemistry and biological activity of vitamins.

Unit-III

Classification, structural determination, linkages, stereochemistry and biologicalv activity of carbohydrates.

Unit-IV

Classification, structural determination, linkages, stereochemistry, biological activity of steroids with reference to cholesterol, bile acids, sex harmones, corticoids,(gluco & mineralo- corticoids) cardiac glycosides and saponins.

Unit-V

1. Introduction to glycoproteins, lipoproteins and glycopeptidolipids.
2. Fullerens- Introduction, chemical reactions and applications.
3. Enzymes-Immobilized enzymes/ cells in organic synthesis.

Book Recommended

1. Text Book of Polymer Science, Fred. W.Billmeyer, 3rd edition, Wiley Interscience Publication, John Wiley and Sons.
2. Introduction to Polymers Sciences and Technology, S.D. Dawande,1st edition, Denett and Co., Nagpur.
3. Polymer Science, V.R.Gowarikar, N.V.Vishwanathan, Jayadev Sreedhar, New Age International , New Delhi.

4. Polymers in Drug Discovery,Ijeoma.F.Vihegbu,Andreas G.Scchatzlein, Taylor and Francis.
5. Biodegaradable hydrogels for drug delivery, Kinam Park, Waleed S.W.Shalaby, CRC Publisher.
6. Organic Chemistry, IL Finar, Vol.-I and II,6th Edition , Pearson Education Asia.
7. Chemistry of Natural Products, S.V.Bhat, B.A.Nagasampegi, M.Sivakumar, Spiringer Publication.
8. Glycopeptides and Glycoproteins, Synthesis, structure and Applications Volume Edition, V.Whittmann, Springer Publications.
9. Current Science, Vol.-91, No.5, 10th September 2006.
10. New J.Chem,.2008, Royal Society of Chemistry, 2008.
11. Perfect Symmetry, Jim Baggott, 1994, Oxford University Press.
12. Charles E.Carraher Jr ' Polymer Chemistry sixth edition, Marcel Dekker Inc. New York.

PHAR-528 P Polymers and Bio-organic Chemistry
Practical Based on Theory syllabus

Third and Fourth Semester

PHAR- 611 Dissertation
PHAR- 612 Presentation & Viva-Voce