

उत्तर प्रदेश प्राविधिक विश्वविद्यालय, लखनऊ, भारत
Uttar Pradesh Technical University, Lucknow, India



**Syllabus M.Pharm
(Pharmacognosy)**

STUDY AND EVALUATION SCHEME

Course: M. Pharm. (Pharmacognosy) 2008 – 09

Semester-I

Sl. No	Course Code	Subject Theory	Period (hours/week)		IA		ESE		Subject Total	
			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 519	Evaluation of Drugs	4	-	30	-	70	-	100	
5	PHAR 520	Advances in Pharmacognosy	4	-	30	-	70	-	100	
Practical							Day to Day Evaluation			
6	PHAR 511P	Modern Analytical Technique		6		30	-	70	100	
7	PHAR 519P	Evaluation of Drugs		6		30	-	70	100	
Total									700	

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. (Pharmacognosy)

Semester-II

Sl. No	Course Code	Subject	Period (hours/week)		IA		ESE		Subject Total
		Theory	T	P	T	P	T	P	
1	PHAR 529	Recent Development in Pharmacognosy	4	-	30	-	70	-	100
2	PHAR 530	Industrial Pharmacognosy	4	-	30	-	70	-	100
3	PHAR 531	Phytopharmaceuticals	4	-	30	-	70	-	100
4	PHAR 525	Synopsis of the proposed dissertation		8					100
Practical			Day to Day Evaluation						
6	PHAR 530P	Industrial Pharmacognosy	-	6	-	30	-	70	100
7	PHAR 531P	Phytopharmaceuticals	-	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. (Pharmacognosy)

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	

T- Theory, P- Practical, IA- Internal Assessment, ESE- End Semester Examination

M. Pharm (Pharmacognosy) (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 shift reagents for elucidation of structures. Fundamentals of Optical Rotatory Dispersion. Cotton effect curves, octant rule, circular dichroism.

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. ¹H 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 ¹³C 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 ¹³C 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.

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, San 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, Palgrave, 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 Chaugankar, 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, LD₅₀, ED₅₀, 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-519

Evaluation of Drugs

Unit – 1

Evaluation of Drugs: Concept, considerations, parameters and methods of quality control for medicinal plant materials as per various pharmacopoeia and other guidelines. Preparation of monograph of crude drug. Comparative study of IP, European Pharmacopoeia, BP / Ayurvedic Pharmacopoeia of India / Ayurvedic formulary of India and WHO guidelines in relation to above.

Application of chromatographic techniques in separation and identification of natural products. Only interpretation of data UV, IR, NMR, ¹H NMR, ¹³C NMR & Mass spectroscopy for purification and structural elucidation of phytoconstituents. Herbal fingerprint profile of single and multicomponent herbal drugs. Stability testing of natural products.

Unit - 2

Analysis of Ayurvedic Formulations and crude drugs with references to: Identity, purity and quality of crude drugs. Determination of pesticide residues, determination of arsenic and heavy metals, determination of microorganisms, determination of microbial load in crude drugs. Identification of aflatoxins in crude drugs. Quality assurance in herbal drug industry, concept of GMP and ISO-9000.

Unit – 3

A. Quantitative microscopy, including lycopodium spore method as applied to drug evaluation and pollen grain analysis. Principles and procedures of microtomy and advanced histological techniques as applied to Pharmacognosy.

B. Principle and procedure involved in biological test of the following:

- i. Presence of Mycobacterium tuberculosis
- ii. Living contaminants in vaccines
- iii. Determination of toxic elements

Unit – 4

Study of pharmacological screening methods of the following categories of drugs: Antiinflammatory, hypolipidemic, diuretics, cardiovascular, hepatoprotectives, anticancer, antidiabetics, antiulceratives, antioxidants, immunomodulators, antimalarial, antimicrobial, antiallergic and antifertility.

Unit - 5

Regulatory requirements for new drugs: Markers constituents- Definition, importance in crude drug standardization. Examples of Biomarkers. Standardization, quality, efficacy and safety requirements & assessment procedures for herbal medicines as per USFDA.

PHAR-519P

Evaluation of Drugs

Practicals based on theory.

Books Recommended:

1. Vogel, Drug Discovery and Evaluation.
2. Dhawan, B.N., Shrimal, R.C., Use of Pharmacological Techniques for the Evaluation of Natural Products, CDRI, Lucknow.
3. Ayurvedic Formulary of India.
4. Ayurvedic Pharmacopoeia of India.
5. Indian herbal Pharmacopoeia.
6. Ashutosh Kar, Pharmacognosy and Pharmacobiotechnology, New Age International Publishers.
7. Indian Pharmacopoeia 2007.
8. European Pharmacopoeia 6th Edn. 2008.
9. Pulok K. Mukherjee, Quality Control of Herbal drugs. An Approach to Evaluation of Botanicals.
10. Quality Control Methods for Medicinal Plant Material, WHO Headquarters, Geneva.
11. Standardization of Botanicals by V. Rajpal, Vol. I & II, Eastern Publishers, New Delhi.
12. Evans, W.C., Trease & Evans Pharmacognosy, W.B. Saunders & Co. London.
13. WHO guidelines, Methodologies on Research for Drug Development and Evaluation of Traditional Medicines.
14. Willard, H.H., Merrit, L.L., Dean, J.A., Settle P.A., Instrumental Methods of Analysis, Van Nostrand.
15. Skoog, D.A., Heller, F.J., Nieman, T.A., Principles of Instrumental Analysis, W.B Saunders.
16. Hunson, J.W., Pharmaceutical Analysis - Modern Methods, part A & B, Marcel Dekker.
17. Schirmer, R.E., Modern Methods of Pharmaceutical Analysis, Vol. 1, 2, Boca Raton F.L: CRC Press.

18. Mann, C.K. et al., Instrumental Analysis, Harper & Row.
19. Jaffe, H.H., Orchin, M., Theory & Applications of Ultraviolet Spectroscopy, Willy.
20. Silverstein, R.M., et al., Spectrometric Identification of Organic Compounds, Willy.
21. Bovey, F., Jelinski, L, Miran, P., Nuclear Magnetic Resonance Spectroscopy, Sau: Diego Academic.
22. Stothers, J.B., Carbon-13 NMR.Spectroscopy, Academic.
23. Gordy, W., Theory & Applications of Electron Spin Resonance, Willy.
24. Haswell, S.J., Atomic Absorption Spectroscopy, Elsevier.
25. Ardrey, R.E., Pharmaceutical Mass Spectra, Pharmaceutical press, London.

26. WHO Monographs on Selected Medicinal Plants, Vol. I & II.
27. WHO Quality Control Methods of Medicinal Plant Materials.
28. WHO, International Pharmacopoeia, Vol. I-V.
29. Wilfried, M.A., Niessen, Liquid Chromatography-Mass Spectrometry.
30. Harry, G. Brittain, Spectroscopy of Pharmaceutical Solids.
31. Indian Herbal Pharmacopoeia, Vol. 1 & 2.
32. Wallis, T.E., Practical Pharmacognosy.
33. Gorag, Steroid Analysis in Pharmaceutical Industry.
34. Wagner's, Plant Drug Analysis, A Thin layer Chromatography, Atlas.
35. Bogers, Medicinal and Aromatic plants, Agricultural, Commercial, Ecological, Legal, Pharmacological and Social Aspects.

PHAR-520

Advances in Pharmacognosy

Unit - 1

Biotechnological: mutation, polyploidy and hybridization to improve the quality of vegetable drugs and their constituents, chemical races.

Unit - 2

Plant growth regulators and their use, scope and limitations in Pharmacognosy, Effect of growth hormones on production of secondary plant metabolites.

Unit - 3

Nutraceutical: A biochemical background of use of herbal products, anthocyanins, proanthocyanidins, flavanones and resveratrol.

Unit --4

Antibacterial, antiviral, hypolipidemic, anti-inflammatory, anti-malarial, hepatoprotective, antidiabetics and anticancer drugs from natural origin, Their recent advances as reported in literature.

Biological allergens and hallucinogens.

Unit - 5

Marine Pharmacognosy: Definition, present status, classification of important bioactive agents, their general methods of isolation and purification (where reported), study of important bioactive agents including their chemistry and uses.

Books Recommended:

1. Evans, W.C., Trease and Evans Pharmacognosy W.B., Saunders & Co. London.
2. Plant Drug Analysis by Wagner.
3. Rajdan, M., Introduction to Plant Tissue Culture, Oxford IBH Publishing Co. Pvt. Ltd., New Delhi.

4. Martin Dean F, Gorge Padilla, Marine Pharmacognosy.
5. Human Medicinal Agents from Plants Manual F. Balandrin, American Chemical Society.
6. Natural Products, Drug Discovery and Therapeutic Medicines, Human press.
7. Pharmacognosy and Phytochemistry by Mohammad Ali, CBS Publishers & Distribution, New Delhi.
8. Kalia, A.N., Text Book of Industrial Pharmacognosy.
9. Vyas, S.P., Dixit, V.K., Pharmaceutical Biotechnology.
10. Tyler, Brady and Robbers, Pharmacognosy.
11. Jarald, Text Book of Pharmacognosy and Phytochemistry.
12. PDR for Nutritional Supplements.

(Second Semester)

PHAR-529

Recent Developments in Pharmacognosy

Unit - 1

Immunity, Immunomodulatory drugs of plant origin.

Unit - 2

Ethnopharmacognosy / Ethnomedicine, its concept, scope and importance.

Unit - 3

Aromatic plant resources in India.

Screening: Chemical screening procedures of vegetable drugs of medicinal importance.

Unit - 4

Plant tissue culture techniques & its application in relation to phytopharmaceuticals: Techniques of initiation & maintenance of various types of cultures, Immobilized cell techniques (survey of recent advances), Germ plasm storage, biotransformation studies, recent advances in elicitor techniques and production of biological active constituents in static, suspension, multiple shoot cultures. Bioreactors for production of biologically active constituents and other applications of plant tissue culture techniques. Biosynthetic potential of tissue cultures and factors affecting production of secondary metabolites by tissue culture techniques.

Unit - 5

Comparative Phytochemistry, its history, concepts, applications and methods, DNA finger printing.

Books Recommended:

1. Street, H.C., Plant Cell and Tissue Culture, Blackwell scientific, London.
2. Textbook of Industrial Pharmacognosy by Dr. Kalia, A.N.
3. Evans W.C., Trease and Evans Pharmacognosy, W.B. Saunders & Co., London.
4. Atal, C.K., Kapur, B.M., Cultivation and Utilization of Medicinal and Aromatic Plants, R.R.L., Jammu.
5. Medicinal and Aromatic Plant Abstracts (MAPA), CSIR, New Delhi.
6. Street, H.E., & G.G., Henshaw, In cells and Tissues in culture, Vol. 3, London, Academic Press.
7. Tulecke, W., In Reproduction; Molecular, Subcellular and cellular, Academic Press, New York.
8. Woreing, P.F., and Phillipe, I.P.J., Control and Growth and Differentiation in Plants, Pergemon Press.
9. Staba, E.J., Applied and Fundamental Aspects of Plant Cell, Tissue and organ culture (Reivert J. and Y.P.S., Bajaj Ed.), Berlin.
10. Tabata, M., Plant Tissue Culture and its Biotechnological Applications, Springer, Berlin.
11. Reinhard, E., Tissue Culture and Plant Science, Academic Press, London.

12. Zunk, M.H., Shagi, E.L., Arens, H, Stoebigt, J., Weller, E. and Deus, B., Plant Tissue Culture and its Biotechnological Applications, Springer.
13. Harborne, Phytochemical Methods: A Guide to Modern Techniques of Plant Analysis.
14. Khan, Irfan A., Ethnomedicinal Human Welfare, Vol. I-IV.
15. Khan Irfan, A., Role of Biotechnology in Medicinal and Aromatic Plants Vol. I-VIII.
16. Razdan, M.K., Introduction to Plant Tissue culture, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
17. Swain, T., Chemical Plant Taxonomy Academic Press, London.
18. Kishore, Plant Tissue culture and Biotechnology.
19. Wagner, Plant Drug Analysis.
20. PDR for Herbal Drugs.
21. Kirtikar and Basu, Indian Medicinal Plants.
22. Wiart, Ethanopharmacology of Medicinal Plants; Asia and the Pacific.
23. Zang, Natural Product: Drug Discovery and Therapeutic Medicine.

PHAR-530

Industrial Pharmacognosy

Unit - 1

Scope of plant drugs cultivation, factors affecting quality of plant and animal drugs. Substitution and adulteration of crude drugs.

Unit - 2

WHO guidelines on good agricultural and collection practices (GACP) for medicinal plants.

Unit - 3

Problems and recent trends in pest management, scope of biological control and use of environment friendly pesticides especially plant derived products, Pyrethroids, pheromones and juvenile hormones.

Unit - 4

Cultivation and management of medicinal plants: Dioscorea, Belladonna, Hyoscyamus, Cinchona, Opium, Digitalis, Senna, Plantago, Mentha, Rauwolfia, Lemmon Grass, Basil, Geranium. Utilization of waste product of herbal industries.

Unit - 5

Methods of preparation of herbal cosmetics for skin, hair and dental care. Determination of shelf life of raw drugs, powdered drugs, extracts, fractions and finished products.

PHAR-530P

Industrial Pharmacognosy

Practicals based on theory.

Books Recommended:

1. Atal, C.K., Kapur, B.M., Cultivation and Utilization of Medicinal and Aromatic Plants, R.R.L. Jammu.
2. Farooqui, A.A., Sreeramu, B.S., Cultivation of Medicinal and Aromatic Plants University press, 2001.
3. Yoganasimhan, S.N., Medicinal Plants of India, 1st Edition, Interlive Publishing Pvt. Ltd.
4. Medicinal and Aromatic Plant abstracts (MAPA) CSIR, New Delhi.
5. Evans, W.C., Trease and Evans Pharmacognosy, W.B. Saunder & co., London.
6. Wallis, T.E., Text Book of Pharmacognosy.
7. Indian Herbal Pharmacopoeia.
8. Kalia, A.N., Textbook of Industrial Pharmacognosy.
9. Mohammad Ali, Pharmacognosy and Phytochemistry.
10. Bruneton Jean, Pharmacognosy and Phytochemistry of Medicinal Plants.
11. Kaufmann, Natural Products from Plants, CRC Press, New York.
12. Butler, M., Poucher's Perfumes, Cosmetics and Soaps.
13. Panda, Herbal Soaps and Detergents.
14. Vimladevi, Text Book of Cosmetics.
15. D'Amelio, Botanicals, A Phytocosmetic Desk reference.

PHAR- 531

Phytopharmaceuticals

Unit - 1

Methods of investigation of biosynthetic pathways, tracer techniques and autoradiography.

Unit - 2

Drug Constituents and their biosynthesis:

Alkaloids: Ephedrine, Hyoscyamine, Quinine, Morphine, Ergometrine, Reserpine, Vincristine.

Glycosides: Digitoxin, Scillaren, Glycyrrhizin.

Steroids: Sitosterols, Hecogenin, Diosgenin.

Coumarin: Umbelliferone.

Flavones: Hesperidin, Myrecetin.

Antibiotics: Penicillin, griseofulvin, Tetracycline.

Unit -3

Distribution, Isolation, Purification and Characterization of bioactive chemical constituents as follows:

Steroids: Diosgenin, Hecogenin, guggulosterone and withanolides.

Alkaloids: Morphine, Ergometrine, Quinine, Reserpine, Strychnine, Vincristine, piperine, Berberine, Vasicine.

Glycosides: Digitoxin, Sennosides, Bacosides.

Volatile oils: Lemongrass oil, camphor, menthol, Eugenol.

Antibiotics: Penicillin, Streptomycin, Tetracycline.

Vitamins: Cyanocobalamine

Others: Taxol.

Unit - 4

Venom and antivenom, Antihaemophilics, Fibrinogen and Thrombin.

Unit - 5

Structural elucidation of natural products using conventional synthetic, degradative and spectral methods - an insight, giving examples.

PHAR-531 P

Phytopharmaceuticals

Practicals based on theory.

Books Recommended:

1. Evans, W.C., Trease and Evans Pharmacognosy, W.B., Saunders & co. London.
2. Jean Bruneton, Pharmacognosy and Phytochemistry of medicinal plants Techniques and Documentation, Lavoiser, 1995.
3. Wickery, M.L., Secondary Plant Metabolism, MC Millan Press, London.
4. Introduction to Alkaloids, A Biogentic Approach, Willy, New York.
5. Vinod D. Rangari, Pharmacognosy and Phytochemistry, Career publication, Nashik.
6. Tyler, E., Brady, R., Pharmacognosy, Philadelphia P.A., U.S.A.
7. Kaufmann, Natural Products from Plants, CRS Press, New York.
8. Nakanishi K., Chemistry of Natural Products, Kodausha Book Publishing Company, Osaka (Japan).
9. Swain, T., Chemical Plant Taxonomy, Academic Press, London.
10. Harborne, J.B., Phytochemical Methods, Chaparan & Hall, London.

11. Sim, S.K., Medicinal Plant Guidelines, University of Toronto Press.
12. Sim, S.K., Medicinal Plant Alkaloids, University of Toronto press.
13. Cordell, G.A., The Alkaloids - Chemistry and Pharmacognosy, Academic Press, London.
14. Raphael, Ikan, Natural products, A Laboratory Guide, Academic Press, INC.
15. Finar, I.L., Organic Chemistry, Stereochemistry and the Chemistry of Natural Products, U.S.A.
16. Silverstein, Spectrometric Identification of Organic Compounds, John Willy & Sons INC, New York.
17. Agarwal, O.P., Chemistry of Organic Natural Products, Krishna Prakashan Media (P) Ltd., Meerut, India.
18. Mohammed Ali, Pharmacognosy and Phytochemistry, Vol. I, II, CBS Publication & Distributors, New Delhi.
19. Kalia, A.N., Textbook of Industrial Pharmacognosy.
20. Jarald, E.E., Jarald, S.E., Textbook of Pharmacognosy and Phytochemistry.
21. Encyclopedia of Chemical Technology, The Inter Science Encyclopedia, New York.
22. Dewick, Medicinal Natural Products, A Biosynthetic Approach.

(Third & Fourth Semester)

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