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NORTH MAHARASHTRA UNIVERSITY,
JALGAON.

# Syllabus for

# B.PHARMACY

# (FINAL YEAR)

(W.E.F. July, 2001)

## NORTH MAHARASHTRA UNIVERSITY, JALGAON

## SCHEME OF EXAMINATION OF B. PHARMACY.

### FINAL YEAR B. PHARMACY.

***( With effect from July, 2001 )***

| Sr. No. | Subjects | Theory | | | | Practicals | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | University | | Sessional | Total | University | | Sessional | Total |
| | | Hrs. | Marks | Marks | Marks | Hrs. | Marks | Marks | Marks |
| 4.1 | Pharmaceutics - III | 03 | 80 | 20 | 100 | 06 | 80 | 20 | 100 |
| 4.2 | Biopharmaceutics & Pharmacokinetics | 03 | 80 | 20 | 100 | -- | -- | -- | -- |
| 4.3 | Pharmaceutical (Medicinal) Chemistry | 03 | 80 | 20 | 100 | 06 | 80 | 20 | 100 |
| 4.4 | Pharmaceutical Analysis - III | 03 | 80 | 20 | 100 | 06 | 80 | 20 | 100 |
| 4.5 | Pharmacology & Bioassay | 03 | 80 | 20 | 100 | 06 | 80 | 20 | 100 |
| 4.6 | Pharmacognosy & Phytochemistry - II | 03 | 80 | 20 | 100 | 06 | 80 | 20 | 100 |
| 4.7 | Pharmaceutical Jurisprudence & Marketing Management | 03 | 80 | 20 | 100 | -- | -- | -- | -- |
| | | | | **Total:** | **700** | | | | **500** |

**Grant Total: 1200**

# NORTH MAHARASHTRA UNIVERSITY, JALGAON

## STRUCTURE OF B. PHARMACY COURSE & SCHEME OF TEACHING

# FINAL YEAR B. PHARMACY

**( With effect from July, 2001)**

| Sr. No. | Subject | Theory | Practical |
|---|---|---|---|
| 4.1 | Pharmaceutics - III | 03 | 03 |
| 4.2 | Biopharmaceutics & Pharmacokinetics | 03 | -- |
| 4.3 | Pharmaceutical (Medicinal) Chemistry | 03 | 04 |
| 4.4 | Pharmaceutical Analysis - III | 02 | 03 |
| 4.5 | Pharmacology & Bioassay | 03 | 03 |
| 4.6 | Pharmacognosy & Phytochemistry - II | 02 | 03 |
| 4.7 | Pharmaceutical Jurisprudence & Marketing Management | 03 | -- |
| | **Total :-** | 19 | 16 |

**NORTH MAHARASHTRA UNIVERSITY, JALGAON**
**FINAL YEAR B. PHARMACY SYLLABUS**
**4.1 –Pharmaceutics-III (Theory)**
(3Hrs/week)
**( *With effect from July, 2001* )**

**Section- I**

| TOPICS | Hrs |
|---|---|
| 1. Parenteral preparations: | |
| a) General requirement: Types and their formulation with reference to powder for reconstitution solution, solutions, suspensions, emulsions and depot preparations, preparation of sterile, water for injection . Pharmacopoeial evaluation of sterile water for injection | 03 |
| b) Containers and closures (glass, plastic and rubber) and their evaluation, form, fill, seal technology, evaluation of containers and closures including a mention of compatibility testing (to be covered more extensively under stability). | 03 |
| c) Design of facilities and environmental control: Basic design concept, cleanliness, classes, air handling(HVAC systems), HEPA filters, Laminar flow, and laminar flow rooms, change room design, materials of construction, sterilization , validation of environment and filters. | 05 |
| d) Personnel factors: Selection. Training, monitoring, and motivation concept to be considered for education of workers – personal hygiene, gowning and entry procedure, restriction in work area and importance of the same. | 02 |
| e) Processing of parenteral products by terminal sterilization, filtration, sterilization and process validation | 03 |
| f) Quality control and Quality Assurance. | 03 |
| 2. Ophthalmic products: anatomy and physiology of the eye, general requirement / safety consideration, formulation, isotonicity adjustment. Isotonicity calculation, manufacture, package, and quality control. Introduction to insert occuserts | 07 |
| 3. Production management: Total Quality Management, materials, inventories, ABC concept, EOQ, cost controls. | 03 |
| 4. Pilot Plant scale up technique- Groups responsibilities- facilities- example of scaling up | 03 |

**Section-II**

| TOPICS | Hrs |
|---|---|
| 1. Blood products: Historical background, exclusion, and inclusion criteria for the donors – collection and storage of blood, whole human blood and products obtained from it including plasma constituents such as fibrinogens, thrombin, globulin's and albumin. Methods used for these and their packaging. Quality control of blood and its constituents- plasma substituents and plasma expanders- production of Dextran by fermentation- official injection of | 08 |

| | | |
|---|---|---|
| | dextran | |
| 2. | Oral and controlled drug delivery: Defination – Historical development, components of a therapeutic system. Classification – details of matrix and diffusion control systems<br>a) Biopharmaceutical aspects – steady state concept and calculation of maintenance dose, loading doses<br>b) Steady state diffusion, laytime, diffusion cells and study of permeability of polymer and biological membranes. Dissolution The diffusion later model, drug release, drug in polymer matrices, effect of porosity and tortuosity, membrane control, reservoir type devices<br>c) Design and evaluation of SR & CR preparations.<br>d) Brief introduction to polymers<br>e) Introduction to Novel Drug delivery: Mucosal, trasdermal, parenteral implants and pumps, I.U.D. osmotic pumps, bioadhesive, targeted delivery, externally modulated devices and delivery. Iontophoresis, sonophoresis etc (No details to be taught) | 18 |
| 3. | Medicated Aerosols: Components, Manufacture and Evaluation | 03 |
| 4. | Stability testing of pharmaceuticals:<br>Mechanism of drug instability. Hydrolysis, oxidation, isomerization, photochemical decomposition of physical instability and polymerization. A revision of review of mechanism of physical instability in dosage forms. Interaction with containers and closures and their evaluation- compatibility testing. Chemical decomposition in the solid state stability testing if drugs and tentative expiration date, OGMP guidelines in stability testing and expiration dating | 06 |
| 5 | Factory layout: Different department, services and utilities | 02 |
| 6. | Optimization of manufacturing processes of different dosage forms. | 02 |
| | **Total Hours:** | **71** |

**Text Books:**

Industrial pharmacy- Lachman et al.

**References Books :-**


1) P'ceutical dosage forms - Ansel.
2) American Pharmacy - Dittert.
3) Remington's Pharmaceutical Sciences - Alfanso R. Gennaro.
4) Bentleys T.B. of pharmaceutics - Rawling.
5) Frbisher - Fundamentals of microbiology.
6) Industrial Pharmacy (Lea & Febiger), Modern Pharmaceutics - (Dekker).
7) Groves - Parenteral Products.
8) Hanlon - H. B. of Package Engg.
9) Swarbrick & Boyan - Encyclopedia of Pharm. Tech,.
10) Modern pharmaceutics- Banker & Boylan

**NORTH MAHARASHTRA UNIVERSITY, JALGAON**
**FINAL YEAR B. PHARMACY SYLLABUS**
**4.1 –Pharmaceutics-III (Practical)**
(3Hrs/week)
***( With effect from July, 2001 )***
**Section- II**

Note: 1) Products may be assayed to evaluate accuracy in regular practicals. Assays are not to be given to students in University examinations.

2) Formulation of different dosage forms should give stress on raw material specifications, preformulation, process controls, and documentation.
3) Pharmacopoeial evaluation of containers for parentrals
4) Formulation and evaluation of the following dosage forms:
   i) SVPs
      a) Ascorbic acid injection I.P.
      b) Calcium gluconate injection I.P.
      c) An injection containing demonstrating co-solvent phenomenon.
      d) An injection containing colloidal calcium with vitamin D.
   ii) LVPs
      a) Sodium chloride and dextrose infusion I P.
      b) An injection containing fat emulsion
   iii) Ophthalmic Preparations
      a) Sulphacetamide eye drop B.P.C.
      b) Tetracycline eye ointment I.P.
      c) Chloramphenicol eye ointment I.P.
   iv) Accelerated stability testing of an injection
   v) In vitro drug release studies for sustained release preparations
vi) Bioavalibility of sulphamethaxazole/ theophylline.

**BOOKS:**


1. Industrial pharmacy- Lachman et al.
2. P'ceutical dosage forms - Ansel.
3. Dittert, sprowl American Pharmacy (J.B. lipincott)
4. Martin, Remingtons Pharmaceutical sciences. (Mack)
5. Harikishan Singn, Pharmacopoeias and Formularies, vallabh Prakashan, Dehli)
6. M.L. Shroff General pharmacy Series
7. Mittal, Pharmaceutical Formulations
8. I.P., B.P., B.P.C., U.S.P.

NORTH MAHARASHTRA UNIVERSITY, JALGAON.
FINAL YEAR B. PHARMACY SYLLABUS.

**4.2 Biopharmaceutics and Pharmacokinetics. (Theory)**

(3 hrs/week)

***( With effect from July, 2001 )***

**Section- I**

| | TOPICS | Hrs. |
|---|---|---|
| 1 | **Introduction :-** Definitions of absorption, distribution, metabolism, excretion, elimination, disposition, first pass effect, enterohepatic - cycling, bioavailability, biopharmaceuticals, pharmacokinetic & pharmacodynamics. | 05 |
| 2. | **Concepts of compartment models:-** Pharmacokinetic of one compartment model drug, mathematical treatment to pharmacokinetic upon I.V.bolus dosing, I V.infusion & first order extravascular input Multicompartment model behaviour(excluding derivation or mathematical treatment), Central & peripheral compartments, distribution phase & pseudo distribution equilibrium phase.<br>Definition of pharmacokinetc parameters including volumes of Distribution, clearance, biological half life, renal clearance, non-renal clearances, additivity of clearance, absolute bioavailability, relative bioavailability, bioequivalance & other miscellaneous parameters. Methods of estimation of pharmacokinetics parameters & parameters of bioavailability/ bioequivalence including method of residuals, rate method & signma-minus method of estimation of renal clearance, area under the curve, area under moment curve, mean residence time. | 09 |
| 3. | Plasma concentration & therapeutic response . An introduction to pharmacodynamics. | 05 |
| 4. | **Non- linear pharmacokinetic** :- Non-linearities in absorption & elimination. Examples of drug showing non- linear absorption or elimination's, individualisation of dosage regimens & non- linear pharmacokinetics. | 05 |
| 5. | **Dosage regimens :-** Factors affecting dosage regimens, utility curve & therapeutic window, multiple dose pharmacokinetics, Fluctuation, accumulation index, steady state concept, time to reach steady state, loading dose, maintenance dose, drugs requiring individualisation of dosage regimens - a discussion. | 05 |

**Section - II**

| | TOPICS | Hrs. |
|---|---|---|
| 1 | **Mechanisms of drug transport :-** Different mechanisms of drug transport, passive transport & pH - partition theory, Facilitated diffusion, Active transport, Blood & its drug binding constituents as carriers of drugs in the body, Perfusion, limitation & permeability limitation in drug transport. | 06 |
| 2. | **Absorption :-**Modified pH - partition theory or effect of unstirred water layer. | 16 |

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| Physiochemical factors affecting the bioavailability of drugs. Dissolution rate & methods of enhancing dissolution rates, official & unofficial methods of estimation of dissolution/ invitro release of drugs from dosage forms. In vitro, in vivo correlation & its significance. Physiology of GIT & oral bioavailability, formulation & dosage forms related factors affecting oral bioavailability, physiochemical & physiological factors affecting bioavailability of drugs from parenteral route- eg, of procain penicillin-G suspension & insulin-zink suspension, basic concepts of intranasal, oral, mucosal, rectal, transdermal, intravagional, opthalmic & intrauterine delivary of drugs. | 04 |
| 3. **Distribution :-** Rate of distribution, perfusion limitation & permeability limitation. Extent of distrubution, plasma & tissue binding of drugs, drugs with small, intermediate & high volume of distribution & their relative plasma & tissue binding. | 05 |
| 4. **Elimination :-** organ clearance concept, Hepatic clearance, hepatic extraction ratio, blood flow limitation in hepatic clearance, first pass effect. | 05 |
| 5. **Clinical application :-** Effect of enzyme induction, enzyme inhibition, blood flow & protein binding on hepatic clearance, bioavailability, steady state plasma concentration & dosage regimens. Renal clearance & mechanism of renal excretion, estimation of renal clearance, factors affecting renal elimination : Clinical application. Biliary clearance, enterohepatic cycling & other miscellaneous modes of drugs elimination. | |
| **Total Hrs. :-** | **65** |

Books:


1. Biopharmaceutics and relevant pharmacokinetics- Wagner J.C.
2. Current concept in the pharmaceutical science: Biopharmaceutics- Swarbrick J.
3. Current concept in the pharmaceutical science: Dosage form design and bioavailability:- Swarbrick J.
4. Fundamentals of clinical pharmacokinetics: Wagner J C.
5. Biopharmaceutics and clinical pharmacokinetics- Gibaldi M.
6. Clinical pharmacokinetics: Concept and application- Rowland M.
7. Biopharmaceutics and clinical pharamacokinetics- Notari R.E.

**NORTH MAHARASHTRA UNIVERSITY, JALGAON**
**FINAL YEAR B. PHARMACY SYLLABUS**
**4.3 –Pharmaceutical (Medicinal) Chemistry-II (Theory)**
(3Hrs/week)
**( *With effect from July, 2001* )**

**Section- I**

| | TOPICS | Hrs |
|---|---|---|
| 1 | Introduction to QSAR | 02 |
| 2. | Introduction to Receptor Concept | 03 |
| 3 | Introduction to Prodrug , soft drug and orphan drug | 02 |
| 4. | Drugs acting on cholinergic nervous systems:<br>Bethanechol, Carbachol, Methacholine, Neostigmine, demecarium, Physostigmine, Ambenonium chloride, Echothiophate iodide, Isoflurophate, Parathion, Paraxon, Malathion, Pralydoxine, Atropine, Acopolamine, Hyscymine, Hoatropine, Dicyclomine*, Cyclopentolate*, Papaverine, Mecamyramine, Piperodolate*, d- Tubocurarine chloride, Succinyl choline chloride, Erophonium bromide. | 06 |
| 5. | Drugs acting on adrenergic nervous system:<br>Methyldopa*. Guanethidine* reserpine, Ephedrine, Phenylpropanolamine, Amphetamine*, Methamphetamine, Phenteramine, Pargyline, Norepinephrine, Epinephrine, Phenylphrine, Isoproterenol, Metarminol, Salbutamol*, Phenoxybenzamine, dibenamine, Tolazoline*, Phentolamine, Sotalol, Propranelol, Practalol, Atenelol, Labetelol, Metoprolol | 06 |
| 6 | General Anesthetics:<br>Ether, Nitrous Oxide, Halothane, Ultra short acting Barbiturates | 02 |
| 7. | Hypotensive agents:<br>Nitrites, amylnitrites, Glyceryl, Nitrite, Sodium nitrite, Tetranitrate, mannitol, tetranitrate, Pentaerythritol tetranitrate, Isosorbide mononitrate, isosorbide dinitrite. | 02 |
| 8. | Analgesics, antipyretics and anti-inflammatory agents<br>Aspirin*, Acetoaminophen*, Phenylbutazone*, Oxyphenbutazone, Ibuprofen, sulindac, naproxin, Probencid, Allopurinol, ketoprofen, Oxycams like Piroxicam, Mimesulide, Fenamates. | 05 |
| 9. | Narcotics Analgesic Agents:<br>Morphine, Oripavin, Codeine, Ethylmorphine, Dihydroxycodiene*, Metopan, Levarphanol, Dextromethrphan, Meperidine*, Aniliridine, Methadone*, Meperidine, Aniliridine, Methadone, Mepiridine, Dextropropoxyphen and Pentazocine. | 04 |
| 10. | Non-narcotic analgesic agents<br>Dextropropoxyphen* and Ethoheptazine, Morphine antagonists, n- Allyl-nor morphine levellorphone, naloxene | 02 |
| 11. | Drugs acting on Alzheimers disease:<br>Tacrine, Velnacrine, Aniracetam, Sibopiridine. | 02 |
| 12. | Antihyperlipidemic agents:<br>Lipoproteins- Classes and metabolism- Hyperlipoproteinearnias, types and | 02 |

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| therapy. Drugs- clofibrate, gemfibrozil, HMG COA reductase inhibitors(Provastatine, Lovastatin, Simvastatin), Resins-Cholestyramine | |

**Section- II**

| TOPICS | Hrs |
|---|---|
| 1. Drugs acting on central nervous system<br>a) Hypnotic and sedative:<br>Chloral hydrate, Ethionamate, Glutethimine*, Phenobarbitol, Talbutal, Pentobarbital*, Secobarbital, Hexobarbital, Nitrazepam, Bromazepam, Temazepam, Midalzolam | 05 |
| b) Drugs acting as anticonvulsants:<br>Phenetoin*, Mephentoin, Trimethadione, Paramethadione, Clonazepam, Phensuximide*, ethisuximide, Phenacimide, Phenobarbital, Mephobarbital, (Classification of barbiturates), Metharbital, Primidone, Carbamazepine, Sodium Valproate. | 04 |
| c) Psychotherapeutics agents: Phenothiazine such as<br>Chlorpromazine*, Triflupromazine, Fluphenazine, Carphenazine, Chlorprothixine, Thioridazine, Fluplenthixol, Haloperidol, Chlorodiazepoxide, Flurazepam, Oxazepam, Diazepam*, Meprobamate*, Imipramine, desipramine, Amitriptyline, Nortriptyline, Doxepin, Phenelzine, Nialamide, Tranylcypronine, Pargyline, Fluoxetine, Loxapine, Melindone, Pimozide. | 05 |
| d) CNS stimulant:<br>Phenmetrazine, Phendimetrizide, Fenfluramine, Methyl phenidate, nikethamide, Ipromiazide, Picrotoxines, Tetrazole, and Hydrazine derivatives (5 only), Amphetamine, Methamphetamine. | 02 |
| 2. Antihistaminic and antiemetics and antiulcer drugs:<br>Metroclopramide, Diphenhydramine*, Doxylamine, Triprolidine, Chloropheniramine*, Antazoline, Cyproheptadine, Terferadine, Cimetidine, Omeprazole, Lansoprazole, Ranitidine, Famotidine, Ondansetron, Tripelenamine*. | 05 |
| 3. Steroids:<br>a) Classification of steroid, configuration, and conformation<br>b) Adrenocorticoids: Cortisol, Hydrocortisol acetate, fludrocortisone acetate, Betamethasone, Flucinolone, Acetomide, Triamcindone, Methyl prednisolone,<br>c) Androgens and anabolic steroids: Testosterone, Fluoxymesterone.<br>d) Estrogens: Ethyl estradiol, Estradiol, Mestramol, Chlorotrainisene, Estrone, Dienesterol, Diethylstilbestrol, and other non steroidal estrogens<br>e) Progestational agents: Progesteron, Norethindroe, Norgestrel, Dimethisteron. Introduction to a steroid molecule, the following functional groups:<br>1. 9-Alpha-fluoro-11-beta hydroxy<br>2. 17-Alpha-Ethyml and 17- Beta Methyl<br>3. 16- Alpha, 17- Beta Acetonide. | 08 |

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|---|---|---|
| | f) Oral contraceptives. | |
| 4. | Drugs acting on Parkinsonism.<br>Benzotropine mesylate, Procylidine, Orphendine hydrochloride, Ethoprapazine, Levodopa, carbidopa, Benserazide, Amantadine*. | 02 |
| 5 | Cardiovascular and antihypertensive agents:<br>Calcium channel blockers, lantosides A,B,C, Strophanthin, Gitoxin, Digoxin, Quinidine, Procainamide*, Nifedipine*, Amlodipine, Verapamil, Antihypertensive agents which elicit their action through autonomous nervous system previously described under 1 and 2, Clonidine*, Diazoxide, Hydrazone, ACE inhibitors, Enalapril and related drugs, Vasodilators such as Amyl nitrate, Nitroglycerine, Isoxsuprine, Nylidrin, Sodium Nitriprusside | 06 |
| | **Total Hours:** | 75 |

The above classes of drugs should be discussed in relation to:

1. Introduction to rational development (if any)
2. Mechanism of action.
3. Synthesis of compounds with asterisk(*).
4. Structure- activity relationship
5 Generic names
6. Chemical nomenclature
7. Detailed classification of each class

**Text Books:**


1 Principals of medicinal chemistry, Foye, Lemke and Wiliams, Indian edition B I Waverly Pvt. Ltd. New Delhi 1995.
2. Wilson and Gisvold, Textbook of Organic And Pharmaceutical Chemistry, J,N. Delgado, W.A. Remers
3 Kadam S.S , Mahadik K.R., Bothra K G. , Principles of Medicinal Chemistry,


**Reference Books:**


1 J.B. Stenlake Vol I&II: Foundations of Molecular Pharmacology- The Chemical basis of drug action.(Athlone Press- The University of London)
2 Essentials of Medicinal chemistry by Koralkovas, 2nd edition, Wiley- Inter-scienoe Pub 1988.
3 The Organic chemistry of Drug Synthesis: Daniel Ledmicer, John Wiley and Sons Inc. Vol. 1-6
4. Profiles of Drug Synthesis: V.N. Gogte.
5 Burger's Medicinal Chemistry and Drug Discovery(Vol 1-5) Wiley Inter science Pub.
6 Textbook of Pharmaceutical Chemistry by harkishansing & Kapoor.

**NORTH MAHARASHTRA UNIVERSITY, JALGAON**
**FINAL YEAR B. PHARMACY SYLLABUS**
**4.3 –Pharmaceutical (Medicinal) Chemistry-II (Practicals)**
(4Hrs/week)
***( With effect from July, 2001 )***

1. Synthesis of sulphanilamide:
   Step I- Synthesis of Acetanilide
   Step-II- Synthesis of Paracetamidobenzene sulphonyl chloride.
   Step-III- Synthesis of Paracetamidobenzene sulphonamide.
   Step IV- Synthesis of Sulphanilamide.
2. Synthesis of Cinnamic acid:
   Step:-I Synthesis of Benzaldehyde.
   Step-II Synthesis of Cinnamic acid.
3. Synthesis of Chloramin-T
   Step-I Synthesis of Toluene P-sulphonamide
   Step-II Synthesis of Dichloramine-T
   Step-III Synthesis of Chloramine-T
4. Synthesis of Benzocaine:
   Step-I Synthesis of P- Nitrobenzoic acid.
   Step-II Synthesis of P-Aminobenzoic acid
   Step-III Synthesis of Benzocaine.
5. Synthesis of Phenytoin.
   Step-I Synthesis of Benzoin
   Step-II Synthesis of Benzil.
   Step-III Synthesis of Phenytoin.
6. Synthesis of Benzhydrol.
   Step-I Synthesis of Benzophenone
   Step-II Synthesis of Benzhydrol.
7. Synthesis of Isonicotinic acid/Nicotinic acid
8. Synthesis of Anthraquinone
9. Synthesis of Methyl Salicylate.

Note:-
1. 4 Hrs/Week
2. At least 15 experiments should be carried out
3. Annual practical examination- 6 Hrs

**Books:**
1. Textbook of practical organic chemistry- A.I. Vogel
2. Practical organic chemistry- Mann and Sanders.

**NORTH MAHARASHTRA UNIVERSITY, JALGAON.**
**FINAL YEAR B. PHARMACY SYLLABUS**
**4.4-Pharmaceutical Analysis-III. (Theory)**
(2Hrs/week)
***( With effect from July, 2001 )***

**Section-I**

| TOPICS | Hrs. |
|---|---|
| 1) **Introduction** :- Pharmacopoeial monograph, Literature collection, data handling & expression of analytical results, documentation & record keeping. | 02 |
| 2) Validation of Analytical methods as defined in USP. | 02 |
| 3) Radioimmuno assay (RIA) & related immunoassay techniques, ELISA technique : theory, instrumentation & applications. | 02 |
| 4) **Statistics & statistical quality control** :- Statistics in Q.C., definition of terms, normal distribution, T-test, F-test, linear regression, correlation coefficient. Methods of statistical analysis as applied to sampling & interpretation of results, regression lines, sampling procedures. | 04 |
| 5) **NMR spectroscopy** :- Introduction to NMR, basic principles involved, instrumentation, chemical shift, spin-spin coupling, applications, quantitative analysis. | 06 |
| 6) **Mass spectroscopy** :- Principles & theory, instrumentation, application of mass spectroscopy. Mass spectroscopy-mass spectroscopy (MS-MS). | 06 |

**Section-II**

| TOPICS | Hrs. |
|---|---|
| 1) **Chromatography** :- Terminology, retention time & volume, adjusted retention volume, specific retention volume, relative retention volume, height equivalent to theoretical plate, temperature programming, resolution, partition coefficient, qualitative analysis, column performance, internal standards, normalization, derivatives, detection. Classification of chromatography, adsorption, partition, gas-liquid chromatography, size exclusion (Gel) & ion exchange chromatography to discussed in brief. Column chromatography, paper chromatography, thin layer, high performance thin layer, gas & high performance liquid chromatography & their applications.<br>a) Paper chromatography :- Introduction, ascending, descending, circular & two dimensional chromatography, applications.<br>b) Thin layer chromatography :- Introduction, selection of adsorbent, preparation of the plate, spotting, development of chromatogram, detection of compound, recovery of components, quantitative measurements, applications.<br>c) Gas chromatography :- Introduction, carrier gas, columns, injection system, detectors, thermal conductivity detectors (TCD), electron capture detector(ECD), thermiionic detector(TID), flame ionisation detector(FID), nitrogen phosphorus detector(NPD), photoionization | 20 |

| | | |
|---|---|---|
| | detector(PID), head space analysis, applications, programmed temperature gas chromatography(PTGC), gas chromatography-mass spectroscopy(GCMS). | |
| d) | HPLC :- Instrumentation, pumps (reciprocating pumps, displacement & pneumatic pumps), mobile phase reservoirs, solvent treatment systems, isocratic elution, gradient elution, injection system. Detectors, photometric detectors(single wavelength, multi wavelength, variable wavelength, diode array, fluorescence detectors), refractive index detectors, electrochemical detectors. Columns : analytical columns, guard columns, column thermostats, types of column packaging, HPLC-MS. | |
| e) | Ion exchange chromatography ;- Ion exchange resins, applications. | |
| f) | Gel permeation chromatography - Introduction, apparatus & techniques. | 02 |
| 2) | **Raw Material Analysis (RMA).** | 04 |
| 3) | **Packaging Material Testing (PMT) :-** Testing & primary packaging materials, bottles, tubes, testing foils, permeability of plastics, burst & tensile strength, testing of secondary packaging materials, cartons drop test, folding endurance test. | |
| | **Total Hrs. :-** | **46** |

**BOOKS:**


1. Grant –Statistical Quality Control (MaGraw Hill).
2. Lamprecht- Implementing ISO-9000 series (Dekker)
3. Instrumental methods of analysis- Willard, Dean
4. Instrumental methods of analysis-Ewing.
5. Pharmaceutical analysis-Higuchi and brochmann
6. The quantitative analysis of drugs- Garrat
7. Analytical chemistry- MEITES H.B.
8. IP, USP,BP, European Pharmacopoeia, International pharmacopoeia
9. Analytical profiles of drug substances –Florey
10. Analytical chemistry- garry Chrisian
11. Principles of instrumental analysis- Skoog
12. Chromatography- Haftmann.
13. Chromatography-Browning
14. Calculation of analytical chemistry- Hamlton, simpson and ellis
15. Quality assurance Guide- OPPI
16. Quality control handbook-Juran
17. Vogel textbook of quantitative chemical analysis.

**NORTH MAHARASHTRA UNIVERSITY, JALGAON.**
**FINAL YEAR B. PHARMACY SYLLABUS**
**4.4-Pharmaceutical Analysis-III. (Practicals)**
(3Hrs/week)
***( With effect from July, 2001 )***

1) Identification of drugs & impurities by TLC.
2) Determination of Nitrogen in P'ceutical formulation using Kjaldhal's method
3) Test for evaluation of packaging materials which should include burst strength, tensile strength(using universal or other suitable tester), moisture vapor transmission (using permeability cups) this test can be performed on polyethylene or other plastic as well as craft papers used for packaging
4) Finished product evaluation should include the general test industry including the recording of
   - i) Description
   - ii) pH
   - iii) Viscosity.
   - iv) Optical rotation
   - v) Clarity.
   - vi) Acidity.
   - vii) Alkalinity
   - viii) Limit test.
   - ix) Assay

   Following examples to be considered
   - a) Propanolol injection.
   - b) Chloramphenicol eye drop.
   - c) Frusemide injection.
5) Excipients - Evaluation of following excipients may be considered
   - a) Hydroxypropyl methyl cellulose.
   - b) Carboxy methyl cellulose
6) Determination of the uniformity of dose from isoprenaline aerosol inhalation.
7) Separation of mixtures using paper chromatography.
8) Assay of following finished products as per IP
   - a) Paracetamol tablet.
   - b) Albendazole tablet
   - c) Carbamazapine tablet.

**NORTH MAHARASHTRA UNIVERSITY, JALGAON.**
**FINAL YEAR B. PHARMACY SYLLABUS**
**4.5-Pharmacology & Bioassay. (Theory)**
(3Hrs/week)
***( With effect from July, 2001 )***

**Section-I**

| TOPICS | Hrs. |
|---|---|
| 1) Bioassay :- | 05 |
| a) Principles & importance of bioassay. | |
| b) Bioassay of Tetanus toxoid, Insulin, Digitalis. | |
| c) Pyrogen testing. | |
| 1) Chemotherapy :- | 24 |
| a) Development of chemotherapy. | |
| b) Sulfonamide & trimethoprime. | |
| c) Quinolones & Fluroquinolones. | |
| d) Penicillin & Cephalosporin. | |
| e) Tetracycline & Chloramphenicol. | |
| f) Macroloid antibiotic, Aminoglycoside antibiotic. polyene & polypeptide antibiotics. | |
| g) Chemotherapy of Tuberculosis & Leprosy. | |
| h) Chemotherapy of Malaria. | |
| i) Chemotherapy of Helminthiasis. | |
| j) Chemotherapy of Viral & Fungal diseases | |
| k) Chemotherapy of Malignancy. | |
| l) Chemotherapy of Amoebiasis & other protozoal infections. | |
| 1) Immunopharmacology :- | 04 |
| a) Immunosupressants. | |
| b) Immunostimulants. | |
| c) AIDS. | |
| 4) Drug Induced Diseases. | 04 |

**Section-II**

| TOPICS | Hrs. |
|---|---|
| 1) Pharmacology of Drugs Acting on Central Nervous System. :- | 20 |
| a) Neurohamonal transmission. | |
| b) Alcohols. | |
| c) Sedative & Hypnotic. | |
| d) Anticonvulsant. | |
| e) General Anesthetics. | |
| f) Analgesics & anti-inflammatory agents. | |
| g) Psychotropic Drugs (Antipsychotics, Antidepressants & Anxiolytics). | |
| h) C.N.S. stimulants. | |
| i) Antiparkinsonian drugs. | 06 |

| | |
|---|---|
| 1) a) Insulin & Oral Hypoglycemic Agents.<br>b) Sex Harmones & Oral Contraceptives. | 10 |
| 2) Drug-drug interaction -<br>a) Drug-food interactions<br>b) Classification of Drug-drug interactions<br>c) Basic concepts of mechanism of Drug-drug interactions. | 02 |
| 4) Investigational Drugs. | |

**BOOKS:**


1 Goodmann and Gilman- Pharmacological basis of therapeutics Vol-I & Vol II
2 Satoskar R S. and Bhandarkar- Pharmacology and therapeutics Vol. I & II
3. Lewis pharmacology - Crossland
4. Lourence D R and Bennett- Chemical pharmacology
5. Rang and Dale- Pharmacology
6. Sheth and others- selected topics in experimental pharmacology
7 Perry- Pharmacological experiments on isolated preparation
8 McLeod L.J -Pharmacological experiments on intact preparations
9 Gaitonde B.B and Nanivadekar -Tutorials in pharmacology


## NORTH MAHARASHTRA UNIVERSITY, JALGAON.
## 4.5 -FINAL YEAR B. PHARMACY SYLLABUS
### Pharmacology & Bioassay. (Practical)

(3Hrs/week)

***( With effect from July, 2001 )***

1) To record concentration response curve (CRC) of Acetylcholine using Frog rectus abdominis muscle.
2) To find out the strength of given sample of Acetylcholine by interpolation bioassay using rectus abdominis muscle of frog
3) To estimate the strength of unknown sample of Acetylcholine by Four point bioassay using rectus abdominis muscle of frog
4) Bioassay of Gallamine/ d-tubocurarine using rectus abdominis muscle of frog
5) To study the effect of Adrenaline on isolated heart of frog.(On rate & force of contraction).
6) To study the effect of Acetylcholine on rate & force of contraction of isolated frog's heart.
7) To study the effect of ions on isolated frog's heart (Calcium, Potassium, Sodium).
8) To study the effect of Antagonist on isolated frog's heart. (Acetylcholine & Atropine sulphate).

**Demonstration :-**

1) To study the mydriatic effect of topically applied Atropine on Rabbit eye.
2) To study the Analgesic effect in mice using tail flick method.
3) Determination of LD50 value
4) To study the effect of local anaesthetic on rabbit eye

**NORTH MAHARASHTRA UNIVERSITY, JALGAON.**
**FINAL YEAR B. PHARMACY SYLLABUS.**
**4.6 - Pharmacognosy & Phytochemistry - II. (Theory)**
(2hrs/week)
***( With effect from July, 2001 )***

**Section- I**

| TOPICS | Hrs. |
|---|---|
| 1. **Medicinal Plant biotechnology** - Genetics as applied to medicinal herbs, mutation, polyploidy, hybridization, | 03 |
| Introduction to plant tissue culture as source of biomedicines | 06 |
| 2) General biosynthetic pathway of Atropine, Reserpine, Morphine, Ergometrine, Tannins, Caffine, Camphor, Cholesterol, Triglycerides. | |
| **3) Pharmacognostical and phytochemical study of following category drugs -** | 03 |
| i) **Tannins** - Definition, description, classification. Ashoka, Arjuna, Bahera, Myrobalan , Galls, Pale catechu, Black catechu and Tea. | 06 |
| ii) **Volatile oil and terpenoids** - Definition, composition, chemistry and extraction. Terpeneless volatile oils. study of drugs containing volatile oils - Umbelliferous fruits (Fennel, Ajown, Dill, Coriander, Cumin, Caraway, Anise) Cardamom, Mentha, Cinnamon, Eucalyptus, Clove, Artemissia, Lemon Grass, Citrus Sinensis , Nutmeg, Jatamansi, Camphor, Rasna, Saussurea, Tulsi. Oils used in perfumary - Musk, Citrus oil, Jasmine, Lavender, Sandal wood, Vaj and Pudina | 08 |
| iii) **Alkaloids** - Definition , Distribution, Classification. Study of following drugs - Ashwagandha, Berberis, Lobelia, Belladonna, Datura, Stramonium, Hyoscymus, Coca leaf, Cinchona, Ipecac, Ergot, Rauwolfia, Physostigma, Opium, Vinca, Nux-vomica, Kurchi, Pilocarpus, Ephedra, Clochicum, Coffee beans, Vasaka, Aconite. | 02 |
| 4) Preliminary phytochemical investigation of crude drugs | |

**Section-II**

| TOPICS | Hrs. |
|---|---|
| 3. **Natural pesticides** - Pyrethrum, Nicotine, Neem, Red squill | 02 |
| 4. **Marine drugs** - Cardiovascular drugs, Cytotoxic compounds, Antimicrobial compounds, Antibiotic compounds, Anti-inflammantory and antispasmodic agents and other therapeutically valuable compounds. | 03 |
| 5. **Herbs and Herbal food** - Introduction and medicinal importance of Arnica, Cucumber, Devils, Claw, Fenugreek, Garlic, Onion, Gentian, Ginseng, Hydrocotyle, Golden seal, Hibiscus, Honey, Marigold, Parslev. | 05 |
| 6. I) Introduction and classification of a Ayurvedic dosage forms. | 02 |
| II) Principle involved in manufacture of following Ayurvedic dosage form - Asava, Arishta, Kadha, Bhasma, Gutika, Churna, Ghrita and Taila. | 09 |
| III) Standardisation of Asava, Arishta, Churna & Bhasma. | 04 |
| **Total Hrs. :-** | **53** |

**BOOKS:**


1. Indian Pharmacopoeia.
2. Pharmacognosy- Tyler, Brady and Roberts.
3. Text book of Pharmacognosy - T.E. Wallis.
4. Text book of Pharmacognosy - Trease and Evans.
5. Text book of Pharmacognosy - Kokate and Purohit.

**NORTH MAHARASHTRA UNIVERSITY, JALGAON.**
**FINAL YEAR B. PHARMACY SYLLABUS.**
**4.6 - Pharmacognosy & Phytochemistry - II. (Practicals)**
(3hrs/week)
***( With effect from July, 2001 )***

1 Pharmacognostical study ( including morphology, histology & powder characteristics ) of the following :-
Cinchona, Ipecac Root, Rauwolfia Root, Vinca Leaf, Nux - vomica Seed, Kurchi Bark, Ephedra Stem, Vasaka Leaf, Fennel Fruit, Dill Fruit, Coriander Fruit, Anise, Cardamom Fruit, Cinnamon Bark, Clove Fruit, Eucalyptus Leaf & Neem Leaf.

2. Pharmacognostical study (Morphological) of the following plants:-
Ashoka, Arjuna, Catechu, Bahera, Myrobalan, Galls, Orange peel, Nutmeg, Ajowan, Jatamansi, Sandalwood, Tulsi, Aconite, Pyrithrum, Ergot, Colchicum, Sausurea, Picrrorhiza, Andrographis, Black mustard, Pudina

3. Extaction, Separation by TLC and Identification :-
   i) Alkaloids from Vinca.
   ii) Caffeine from Tea.
   iii) Hesperidine from Orange peel.

4. a) Preparation of Churna.
   b) Preparation of Swaras.
   c) Preparation of Kadha.
   d) Standerdisation of marketed preparation such as Asava, Arishta.

**BOOKS:**


1 Indian Pharmacopoeia.
2 Pharmacognosy- Tyler, Brady and Roberts.
3. Text book of Pharmacognosy - T.E. Wallis.
4. Text book of Pharmacognosy - Trease and Evans.
5. Text book of Pharmacognosy - Kokate and Purohit.
6. Text book of Pharmacognosy (Practical) - Kokate.

**NORTH MAHARASHTRA UNIVERSITY, JALGAON.**
**FINAL YEAR B. PHARMACY SYLLABUS**
**4.7-Pharmaceutical Jurisprudence & Marketing Management. (Theory)**
(3Hrs/week)
**( *With effect from July, 2001* )**

**Section-I**

| TOPICS | Hrs. |
|---|---|
| 1) **Drug & cosmetics act 1940 & rules 1945** :- Extend commencement – imp. Definitions, Drugs Technical Advisory Board & Central Drugs Laboratory – their composition & functions. Ayurvedic / Allopathic drugs, prohibitions – Ayurvedic , Homeopathic and Allopathic medicines in respect of import and export indigenous manufacture, sale or distribution- drugs consultative committee, its composition and functions inspectors their powers and duties – sampling procedure, inspection inquiry, investigation/cosmetics, ayurvedic drugs imported drugs, cosmetics and indigenously manufactures drugs and cosmetics- offences and penalties, confiscation- govt. analyst, licensing authorities and controlling authority qualification, function and powers- licenses for different system for medicine | 10 |
| 2) **Drug and magic remedies act 1954** – Definition, official duties, prohibition, penalties | 06 |
| 3) **Narcotic drugs and Psychotropic substances act 1985-** Historical background of Opium Act & Dangerous Drugs Act. Prohibition & penalties. | 04 |
| 4) **Prevention of Food Adulteration Act 1954 & Rules 1955:-** Important defination , central board of food standard, central food laboratory, composition and functions, public analyst- Qualification, duties, food inspector- Qualification powers, Duties sampling procedure | 04 |
| 5) **Drugs Price Control Order 1987** :- Historical background, Essential Commodities Act., Relevant provisions, Drugs Prices Display Rule 1961 & other relevant orders. Applicability to imported drugs & indigenously manufactured drugs, definitions, prices to wholesale & retailer, MAP, penal provisions. | 02 |
| 6) Pharmacy Act 1948. | 04 |
| 7) Principles of Organization. | 02 |
| 8) Authority, performance, productivity. | 02 |
| 9) Policies, procedures, methods of operating. | 02 |
| 10) Direction, delegation, participation, decision making. | 02 |

**Section-II**

| TOPICS | Hrs. |
|---|---|
| 1) Sales & Marketing Management Concepts. | 01 |
| 2) Behavior of Doctors, Retailers, Customers. | 03 |
| 3) Marketing research | 07 |
| 4) Advertising & sales promotion. | 04 |
| 5) Selling & sales management. | 03 |
| 6) Product Management. | 03 |
| 7) Legal framework of industry. | 02 |
| 8) Human resources planning & audit. | 02 |
| 9) New product selection. | 04 |
| 10) New product management. | 04 |
| 11) Sales forecasting, medium planning & budgeting. | 05 |