Osmania University

Syllabus for M. Pharmacy
(Pharmaceutical Chemistry)
(w.e.f. academic year 2009-10)

Faculty of Technology,
Hyderabad
### Scheme of Instruction and Evaluation for M. Pharmacy (Pharmaceutical Chemistry)

#### I – Semester

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Subject / Paper</th>
<th>Theory / Practical</th>
<th>Instruction Hours per week</th>
<th>Evaluation</th>
<th>Duration of External Examination</th>
</tr>
</thead>
<tbody>
<tr>
<td>M PCH.T.1.101</td>
<td>Pharmaceutical Analytical Techniques</td>
<td>Theory</td>
<td>4</td>
<td>30 70</td>
<td>3</td>
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<tr>
<td>M PCH.T.1.102</td>
<td>Advanced Pharmaceutical Organic Chemistry – I</td>
<td>Theory</td>
<td>4</td>
<td>30 70</td>
<td>3</td>
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<tr>
<td>M PCH.T.1.103</td>
<td>Advanced Medicinal Chemistry – I</td>
<td>Theory</td>
<td>4</td>
<td>30 70</td>
<td>3</td>
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<tr>
<td>M PCH.T.1.104</td>
<td>Advanced Chemistry of Natural Products</td>
<td>Theory</td>
<td>4</td>
<td>30 70</td>
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<tr>
<td>M PCH.P.1.105</td>
<td>Pharmaceutical Analytical Techniques</td>
<td>Practical</td>
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<tr>
<td>M PCH.P.1.106</td>
<td>Advanced Chemistry of Natural Products</td>
<td>Practical</td>
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<td>30 70</td>
<td>6</td>
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<tr>
<td>M PCH.T.1.107</td>
<td>Entrepreneurship Management (SAIL)</td>
<td>Tutorials</td>
<td>2</td>
<td>A/B/C/D</td>
<td>–</td>
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<tr>
<td>M PCH.T.1.108</td>
<td>Seminar</td>
<td>–</td>
<td>8</td>
<td>50</td>
<td>18 20 230 420</td>
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#### II – Semester

<table>
<thead>
<tr>
<th>Subject Code</th>
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<tbody>
<tr>
<td>M PCH.T.1.201</td>
<td>Intellectual Property Rights &amp; Regulatory Affairs</td>
<td>Theory</td>
<td>4</td>
<td>30 70</td>
<td>3</td>
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<tr>
<td>M PCH.T.1.203</td>
<td>Advanced Medicinal Chemistry – II</td>
<td>Theory</td>
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<td>30 70</td>
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<tr>
<td>M PCH.T.1.204</td>
<td>Drug Screening Methods &amp; Biostatistics</td>
<td>Theory</td>
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<td>30 70</td>
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<tr>
<td>M PCH.P.1.206</td>
<td>Advanced Medicinal Chemistry – II</td>
<td>Practical</td>
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<td>30 70</td>
<td>6</td>
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<tr>
<td>M PCH.T.1.207</td>
<td>Scientific and Technical Writing (SAIL)</td>
<td>Tutorials</td>
<td>2</td>
<td>A/B/C/D</td>
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<tr>
<td>M PCH.T.1.208</td>
<td>Seminars</td>
<td>–</td>
<td>8</td>
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SAIL: Self assess Instrumentation Learning
Scheme of Instruction and Evaluation for M. Pharmacy  
(Pharmaceutical Chemistry)

Semester III and IV

**DISSERTATION** – Original research work carried out by the candidate under the guidance of regular teaching faculty/visiting faculty of the department should be submitted in a bound form.

Evaluation of the dissertation shall be done by external and internal examiners appointed by the university.

<table>
<thead>
<tr>
<th>Assessment</th>
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<tbody>
<tr>
<td>Dissertation viva-voce</td>
<td>A/B/C/D/F</td>
</tr>
<tr>
<td>Dissertation report</td>
<td>A/B/C/D/F</td>
</tr>
</tbody>
</table>

A: Excellent   B. Very good   C. Good   D: Fair   F. Fail
UNIT – I

UNIT – II

UNIT – III
Mass Spectrometry: Basic principles and instrumentation (components and their significance). Ionization techniques, mass spectrum and its characteristics, molecular ion, metastable ions, fragment ions; fragmentation processes, fragmentation patterns and fragment characteristics in relation to parent structure and functional groups. Relative abundances of isotopes and their contribution to characteristic peaks.

UNIT – IV
Chromatographic Techniques: Classification of chromatographic methods based on mechanism of separation and their basic principles. Gas chromatography: Instrumentation, column efficiency parameters, derivatisation methods, applications in pharmaceutical analysis. Liquid chromatography: Comparison of GC and HPLC, instrumentation in HPLC, normal and reversed phase packing materials, column selection, mobile phase selection, efficiency parameters, applications in pharmaceutical analysis. Instrumentation and applications of HPTLC, ion exchange chromatography, gel permeation chromatography, chiral chromatography, flash chromatography, and supercritical fluid chromatography (SFC).

UNIT – V
a) Electrophoresis: Principles, instrumentation and applications of moving boundary electrophoresis, zone electrophoresis (ZE), isocaphoresis, isoelectric focusing (IEF), continous electrophoresis (preparative) and capillary electrophoresis. SDS gel electrophoresis and blotting techniques.
b) Radio immunoassay and ELISA: Principle, instrumentation, applications and limitations.
Recommended Books:


UNIT – I

UNIT – II
**Reactive Intermediates:** Definition, generation, stability, structure and reactivity of free radicals, carbocations, carbanions, carbenes, nitrenes/nitrenium ions.

UNIT – III
**Mechanisms of Organic Reactions:** Electrophilic (addition and substitution), Nucleophilic (addition and substitution), elimination and free radical (addition and substitution) reactions.

UNIT – IV
**Pericyclic Reactions:** Electrocyclic, cycloaddition and sigmatropic reactions-introduction, terminology and mechanism with suitable examples.

UNIT – V
**Molecular Rearrangements:**
2. Carbon to nitrogen migration: Hoffmann rearrangement, Curtius rearrangement, Beckmann rearrangement and Lossen rearrangement.
3. Carbon to oxygen migration: Bayer-Villager rearrangement and rearrangement of hydroperoxides.

Recommended Books:
2. Eliel EL, Wilen SH. Stereochemistry of organic compounds. Delhi: John Wiley & Sons; 2008
UNIT – I
Theoretical aspects of drug action: Introduction, brief account on various forces involved in drug-receptor complex, types of receptors. Theories of drug-receptor interactions: 1) occupancy theory, 2) rate theory, 3) induced fit theory, 4) macro molecular perturbation theory, 5) topographical and stereo chemical considerations, 6) Ion channel blockers. Case history of drug development – cimetidine.

UNIT – II
Design and application of prodrugs: Prodrug concept, choice and function of pro-moiety, bioreversible derivatives for various functional groups, applications of the pro-drug approach.

UNIT – III
Targets for the development of following chemotherapeutic agents: antiulcer, analgesic, anti-inflammatory, antifungal, antiangiogenesis and antihypertensive agents.

UNIT – IV

UNIT – V
Genesis of new drugs: Serendipity, random screening, extraction of active principles from natural sources, molecular modification of known drugs, selection or synthesis of soft and hard drugs, and rational drug design.

Recommended Books:
14. Purcell, Strategies of drug design.
UNIT – I
Natural products as leads for new drugs: Introduction/history, approaches to discovery and development of natural products as potential new drugs selection and optimization of lead compounds for further development with suitable examples from antibiotics, CNS, and cardiovascular agents.

UNIT – II
Alkaloids: Introduction and general methods of structure elucidation.
From opium: morphine-structural elucidation, development of morphine analogues and morphine antagonists.
From Rauwolfia: Reserpine-structural elucidation, structural modifications and uses.
From vinca rosea: vincristine and vinblastine - structural modification, semi synthetic derivatives, and uses.

UNIT – III
Steroids: Introduction, nomenclature, stereochemistry of steroids. Source and structure elucidation of cholesterol and diosgenin.
Structures, structural modifications and therapeutic uses of steroidal anti-inflammatory agents and antifertility agents.

UNIT – IV
Polypeptides and proteins: introduction and general methods of separation, general methods of degradation and end group analysis, general methods of synthesis of peptides. Primary, secondary, tertiary and quaternary structure of proteins; chemistry of insulin.

UNIT – V
Miscellaneous compounds: Structure, structural modifications, mechanism of action and therapeutic uses of a) taxanes b) camptothecin c) artemisinic e) ginkolides and f) gymnemic acids.

Recommended Books:
6. Ataur Rahman. Chemistry of natural products
List of Experiments: (Minimum of 8 experiments shall be conducted)

1. UV/Visible spectrum scanning of a few organic compounds for UV- absorption and correlations of structures (5 compounds) and isosbestic point in case of mixtures.
2. Effect of solvents and pH on UV spectrum of drugs. (2 experiments)
3. Estimation of multicomponent formulation by UV- Spectrophotometer in formulations. (2 experiments)
4. Experiments based on the application of derivative spectroscopy. (2 experiments)
5. Experiments based on HPLC (Isocratic and Gradient elution) techniques. (2 experiments)
6. Interpretation of drugs by IR spectra.
7. Workshop of spectroscopy: (UV, IR, NMR, MASS) structural elucidation of at least 5 compounds. (4 experiments)
8. Any other relevant experiments based on theory.
List of Experiments: (Minimum of 8 experiments shall be conducted)

1. Isolation and characterization of the following natural products:
   a. Piperine from black pepper
   b. Hesperidin from orange peel.
   c. Strychnine from Nux vomica seeds.
   d. Curcumin from turmeric powder.
   e. Lycopene from tomatoes.
   f. Myristicin and trimyristicin from nutmeg.
   g. Tannic acid from myrobalan.
   h. Isolation of casein from milk.
   i. Lysozyme from albumen.

2. Extraction and estimation of carvone from caraway seeds.
3. Separation of natural products through column chromatography.
5. Any other relevant experiments based on theory.

References:

ENTREPRENEURSHIP MANAGEMENT

Subject Code: M PCH.T.1.107  
Grade: A/B/C/D
Periods/week: 2  
Examination: --
Nature of Exam: Tutorials  
Exam Duration: --

Course Objectives:
- To provide conceptual inputs regarding entrepreneurship management.
- To sensitise and motivate the students towards entrepreneurship management.
- To orient and impart knowledge towards identifying and implementing entrepreneurship opportunities.
- To develop management skills for entrepreneurship management.

UNIT – I: CONCEPTUAL FRAMEWORK:
- 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: THE 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 ORGANISING AN ENTERPRISE
- Environment scanning – Information, sources, schemes of assistance, problems.
- Enterprise selection, market assessment, enterprise feasibility study, SWOT Analysis.
- Resource mobilisation - 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, co-ordination and feasibility study

UNIT – V: PREPARING PROJECT PROPOSAL TO START ON NEW ENTERPRISE
- Project work – Feasibility report; Planning, resource mobilisation and implementation.

Recommended Books:
UNIT – I
Patents and Intellectual Property Rights (IPR): definition, scope, objectives, source of patient information, patent processing and application. Patents, copyrights, trademarks, silent features, trade related aspects (TRIPS), international and regional agreements.

UNIT – II
GATT and WTO: GATT – historical, prospectives, objectives, fundamental principles, impact on developing countries. WTO-objectives, scope, functions, structure, status, membership and withdrawal, dispute settlement, impact on globalization, India-tasks & challenges.

UNIT – III
Regulatory Affairs: Indian context – requirements and guidelines of GMP, understanding of drugs and cosmetics act 1940 and rules 1945 with reference to schedule M, U and Y.

UNIT – IV

UNIT – V
Documentation: Documentation types related to pharmaceutical industry, protocols, harmonizing formulation development for global filings, NDA, ANDA, CTD, dealing with post-approval changes – SUPAC, handling and maintenance including electronic documentation.

Recommended Books:

6. Hussain. Law of drugs in India.
UNIT – I
**Synthetic Reagents and Applications:** Lead tetra acetate (LTA), n-bromo succinamide (NBS), osmonium tetroxide, lithium aluminium hydride (LAH), sodium borohydride, DCC (Dicyclohexyl carbodimide), and 2,3-dichloro-5,6-dicyano-1,4-benzoquinone (DDQ).

UNIT – II
**Mechanism and applications of reactions and reagents:**
1. Claisen ester condensation,
2. Mannich reaction,
3. Micheal addition,
4. Witting reaction,
5. Synthetic applications of ethyl acetoacetate, diethyl malonate, ethyl cyano acetate.

UNIT – III
**Development & scale up of process for the manufacture of new pharmaceuticals:**
1. Introduction, synthetic route selection, development and scale up, optimization of synthetic routes-yield improvement, investigative approach, streamlining the process.
2. A brief account on Green Chemistry: principles, and applications.

UNIT – IV
**Synthetic Strategies:** Introduction to disconnection approach, consecutive vs convergent synthesis, various strategic approaches in retro synthesis, strategic bond approach- preliminary scan, criteria in disconnection of strategic bonds, identifying strategic bonds in rings.

UNIT – V
**Combinatorial Chemistry:** Introduction, solid phase techniques, parallel synthesis, mixed combinatorial chemistry, deconvolution techniques, tagging, photolithography, limitations of combinatorial chemistry, planning and designing of combinatorial synthesis.

**Recommended Books:**

ADVANCED MEDICINAL CHEMISTRY – II

UNIT – I
Computer aided drug design (CADD):
1. Virtual screening: concept, drug likeness screening, focused screening libraries for lead identification, pharmacophore screening, structure based virtual screening and applications.
2. Molecular modeling: Molecular mechanics, quantum mechanics, modeling ligands for known receptors and unknown receptors.

UNIT – II
Rational Drug design:
Quantitative structure activity relationship (QSAR): Physico chemical properties: hydrophobicity, electronic effects, steric factors-Taft’s steric factor (Es), molar refractivity, verloop steric parameter, other physico chemical parameters.
Methods used to correlate physico chemical parameters with biological activity: Hansch analysis, Free and Wilson approach, Topliss scheme, bioisosteres, planning a QSAR study.
3D QSAR, molecular graphics based drug design and mathematical methods.

UNIT – III
Enzyme Inhibitors: A detailed study of the following types of enzyme inhibitors, related drugs and their pharmaceutical significance.
- P.G. Synthease (Cyclooxygenase and Lipoxygenase) inhibitors,
- Phosphodiesterase (PDE) inhibitors,
- HMG Co A reductase inhibitors,
- Xanthine oxidase inhibitors,
- Angiotensin convertin enzyme (ACE) inhibitors.

UNIT – IV
Anti Viral Agents: Viruses, viral diseases, structure and life cycle of viruses; antiviral agents used against DNA viruses- herpes, chicken pox; and RNA viruses – HIV, influenza.

UNIT – V

Recommended Books:
4. Purcell, Strategy of drug design.
7. Smith & Williams. Introduction to principles of drug design-Harwood academic press.
UNIT – I

UNIT – II
Design of experiment: Principles of randomization, replication and local control, completely randomized block of the above designs in pharmaceutical research, Statistical quality control, process control, control charts, acceptance sampling – sampling plans.

UNIT – III
High throughput screening: introduction, bioassay design, and screen construction-assay design, assay construction, homogenous and non homogeneous biochemical assays and cellular assays.

UNIT – IV
1. Bioassay: Different types: dose effect relationships, calculation of LD\text{50}, ED\text{50} – Probit analysis.
2. \textit{In vivo} screening methods: Antihypertensive, antiarrythmic, cardiotonic, and anticancer and diuretic drugs.

UNIT – V
\textit{In vivo} screening methods: Analgesic, anti-inflammatory, antiepileptic, antidiabetic, and antifertility drugs.

Recommended Books:
2. Vogel H and Volgel WH. Drug discovery and evaluations-pharmacological assays. 2\textsuperscript{nd} ed. Germany: Springer; 2002.
5. Alder HL, Roesseler EB. Introduction to probability and statistics. 12\textsuperscript{th} ed. San Francisco: WH. Freemann and company; 2006.
List of Experiments: (Minimum of 8 experiments shall be conducted)

1. Synthesis and characterization of the following drugs:
   a. Benzanilide by bechmann rearrangement
   b. 4-benzylidene-2-methyloxazol-5-one (or) azalactone
   c. N-(m-nitrobenzyl)aniline from m-nitrobenzaldehyde
   d. 2,3-diphenyl quinoxaline
   e. 1H-indole-3-carbaldehyde
   f. 3,4-dihydropyrimidin-2(1H)-one from benzaldehyde, ethyl acetoacetate and urea in presence of CaCl$_2$ catalyst.
   g. Schiff base by microwave irradiation
   h. Cinnamic acid by perkin reaction
   i. $\beta$-dimethylamino propiophenone hydrochloride (mannich base)
   j. 2-phenyl indole
   k. Dimedone (5,5-dimethyl cyclohexane-1,3-dione)
   l. 3-bromo cyclohexene from cyclohexene using NBS.
   m. p-amino benzyl alcohol from p-amino benzaldehyde using sodium borohydride.
   n. Cyclohexane-2,5-dicarboxylic acid from benzoic acid (hydrogenation).

2. Any other relevant experiments based on theory.

References:

List of Experiments: (Minimum of 8 experiments shall be conducted)

1. Synthesis and characterization of the following drugs:
   a. Phenacetin
   b. Antipyrin
   c. Benzocaine
   d. Uramil
   e. Tolbutamide
   f. Phenothiazine
   g. Isoniazid
   h. Sulphasalazine
   i. aspirin from salicylic acid
   j. paracetamol from p-aminophenol

2. Determination of partition coefficient of any medicinal compound by shake flask method.

3. Any other relevant experiments based on theory.

References:

Course Objectives:
- To be able to appreciate and understand importance of writing scientifically.
- To develop competence in writing and abstracting skills.
- To write either a draft research proposal or a chapter of dissertation.

UNIT – I: COLLECTION AND EVALUATION OF INFORMATION
Identification, sources, searching information, classifying information under fact/opinion, tabulating information, summarizing a text and presenting sequence of topics in different forms.

UNIT – II: WRITING AS A MEANS OF COMMUNICATION
- Different forms of scientific and technical writing.
- Articles in journals, research notes and reports, review articles, monographs, dissertations, bibliographies.
How to formulate outlines: The reasons for preparing outlines
  - as a guide for plan of writing
  - as skeleton for the manuscript
Kinds of outline: topic outlines, conceptual outline, sentence outlines and combination of topic and sentence outlines

UNIT – III: DRAFTING TITLES, SUB TITLES, TABLES, ILLUSTRATIONS
Tables as systematic means of presenting data in rows and columns and lucid way of indicating relationships and results.
Formatting Tables: Title, Body stab, Stab Column, Column Head, Spanner Head, Box Head
Appendices: use and guidelines.
The Writing process: Getting started, Use outline as a starting device, Drafting, Reflecting and Re-reading. Checking: Organization, Headings, Content, Clarity and Grammar.
Brevity and Precision in writing - Drafting and Re-drafting based on critical evaluation

UNIT - IV: PARTS OF DISSERTATION/RESEARCH REPORT/ARTICLE
Introduction, Review of Literature, Methodology, Results and Discussion. Ask questions related to: content, continuity, clarify, validity internal consistency and objectivity during writing each of the above parts.

UNIT – V: WRITING FOR GRANTS
- Clearly state the question to be addressed
- Rationale and importance of the question being address
- Empirical and theoretical conceptualization
- Presenting pilot study/data
- Research proposal, clarity, specificity of method
- Clear organization
- Outcome of study and its implications
- Budgeting, available infra-structure and recourses
- Executive summary
Recommended Books:
2. Cooper HM. Integrating research: a guide for literature reviews, 2\textsuperscript{nd} ed. California: Sage; 1990.