Curriculum and Syllabi

Appendix-A

Course of Study and Scheme of Examination

M. Pharm. (Pharmaceutical Chemistry)

I – Semester

S. No	Sub. Code	Subject	Teaching Hours per Week			Distribution of Marks				
						Theory Marks		Practical Block II		Total I+II
			Theory	Practical	Total	Sessional	Exam	Sessional	Exam.	
1	MPY-101	Modern Analytical Techniques	04	06	10	25	75	25	75	200
2	MPY-102	Biotechnology & Bioinformatics	04	04	08	25	75	25	75	200
3	MPY-103	Drug Regulatory Affairs, IPR and Quality Assurance	04	---	04	25	75	--	--	100
4	MPY-104	Product development & Formulation	04	06	10	25	75	25	75	200
		Total	16	16	32	100	300	75	225	700

II – Semester

	Sub. Code	Subject	Teaching Hours per Week			Distribution of Marks				
						Theory Marks		Practical Block II		Total I+II
			Theory	Practical	Total	Sessional	Exam	Sessional	Exam.	
1	MPY-201 pch	Advanced Medicinal Chemistry	04	--	04	25	75	--	--	100
2	MPY-202 pch	Advanced Organic Chemistry	04	--	04	25	75	--	--	100
3	MPY-203 pch	Advanced Pharmaceutical Chemistry	04	--	04	25	75	--	--	100
4	MPY-204 pch	Drug Design	04	--	04	25	75	--	--	100
5		* Lab (Practical)	--	16	16	--	--	100	200	300
		Total	16	16	32	100	300	100	200	700

*Practical based on theory paper 1 to 4

In second year, third and fourth semester a major research project shall be undertaken by the candidate. A Minor research project has to be undertaken by the candidate in the third semester and evaluation of the same shall be done at the end of the third semester as per the scheme.

SECOND YEAR

Third semester- Mini Project

Seminar/ Viva	Project Report	Total
100	200	300

THIRD AND FOURTH SEMESTER- MAJOR RESEARCH PROJECT

Sessional Work	**Thesis exam and Viva- voice**	**Presentation of Thesis work in the Department**	**Total**
200	400	100	700

First Year (First Sem.)	+	First Year (Second Sem.)	+	Second Year (Third Sem.)	+	Second Year (Fourth Sem.)	= Total
700	+	700	+	300	+	700	= 2400

SYLLABUS

(2010-2011)

MASTER OF PHARMACY

(Pharmaceutical Chemistry)

Rajiv Gandhi Proudyogiki Vishwavidyalaya
(University of Technology of Madhya Pradesh)
Airport Bypass Road, Gandhinagar,
Bhopal.

First Year 1st Semester

DRA, INTELLECTUAL PROPERTY RIGHTS AND QUALITY ASSURANCE

THEORY

1. Requirements of GMP, CGMP, GLP, USFDA, WHO guidelines and ISO 9000 Series.
2. Drugs and Cosmetics Acts and Rules, Drug Regulatory Affairs.
3. Documentation – Protocols, Forms and Maintenance of records in Pharmaceutical industry.
4. Clinical Trials and toxicological evaluation of drugs. Preparation of documents for New Drug Approval and Export Registration.
5. Processing and its application, Intellectual Property Rights (Patent, Copy right and Trade marks).
6. Sewage disposal and Pollution control.
7. Concepts in Validation, Validation of manufacturing, Analytical and Process validation and its Application.
8. Basic concept of Quality Control and Quality Assurance systems, Source and Control of Quality variation of Raw materials, Containers, Closures, Personnel, Environmental, etc.
9. In process quality control tests, IPQC problems in Pharmaceutical industries. ICH Guidelines
10. Sampling plans, Sampling and Characteristic curves.
11. Master formula generation and Maintenance, Standard Operating Procedure (SOP) for different dosage forms.

Books and References Recommended:

1. Willing, Tuckerman and Hitching, **Good Manufacturing Practices for Pharmaceuticals.**
2. **Drugs and Cosmetic Acts and Rules.**
3. Bharathi, **Drugs and Pharmacy Laws in India.**
4. Patel, **Industrial Microbiology.**
5. Loftus, B.T. and Nash,R.A., **Pharmaceutical Process Validation**.
6. Bolton, S., **Pharmaceutical Statistics**.
7. Banker, G.S. and Rhodes, C.T., **Modern Pharmaceutics**.
8. OPPI, **Quality Assurance.**
9. Carletiori, **Validation of Aseptic Pharmaceutical Process.**
10. Garfield, **Quality Assurance Principles for Analytical Laboratories**.
11. **Indian Pharmacopoeia.**
12. **British Pharmacopoeia.**
13. **United State Pharmacopoeia.**

BIOTECHNOLOGY & BIOINFORMATICS

1. **Genetics:** Structure & Function of DNA, DNA Replication & Repair, Expression of Genetic Information: Structure & Function of RNA, Transcription, Genetic code, Translation, Post translational modification.

2. **Recombinant DNA Technology:** Constructing Recombinant DNA molecules Restriction enzymes, Vectors, Gene Cloning, Genomic libraries, Polymerase Chain reaction – based DNA cloning, Restriction mapping, Blotting techniques, DNA sequencing, Pharmaceutical applications of recombinant DNA.

3. **Gene Therapy:** General Introduction, Potential target diseases for Gene therapy, Gene transfer methods, Clinical studies, Pharmaceutical production & Regulation.

4. **Basics of Immunology, Monoclonal antibodies & Hybridoma technology & its Applications.**

    - **Vaccines –** Conventional vaccines, Modern Vaccine technologies, Genetically improved live vaccines, Genetically improved subunit vaccines, Pharmaceutical considerations.

5. **Fundamentals of Cell biology:**

    - **Cell organization and plasma membrane:** Transport of substances across the membrane.
    - **Cellular reproduction:** The Cell cycle, Mitosis & Meiosis, Apoptosis.
    - **Cell Signaling:** Communication between cells and their environment

6. **Molecular biology of cancer:** Causes of Cancer & Genetics of Cancer, New strategies for combating cancer.

7. **Molecular, Structural and Chemical Biology in pharmaceutical research:** Molecular biology of disease and invivo transgenic models, Genomic protein targets and recombinant therapeutics, Structural biology and rational drug design, Chemical biology and Molecular diversity, Gene therapy & DNA/ RNA targeted therapeutics. Future of pharmaceutical research.

8. **Introduction to Bioinformatics:** Biological databases, Sequence analysis, Protein structure, Genetic and physical mapping, Application of bioinformatics in pharmaceutical industries.

9. **Biostatistics** – Graphical representation of Data, Descriptive statistics, Normal distribution, Probability distribution, Sampling & Sampling plans.

Recommended Readings

1. Lehninger ., ***Principles of Biochemistry***
2. Karp, G.,***Cell & Molecular Biology***.
3. Crommelin, D.J., A., and Sindelar R.D., ***Pharmaceutical Biotechnology***.
4. Templeton N.S., and Lasic. D.D., ***Gene Therapy.***
5. Benjamin Lewin, ***Genes***.
6. Watson and Trooze, ***Recombinant DNA Techniques***
7. Lesk., ***Introduction to Bioinformatiics***.
8. Watson, ***Molecular Biology of cell***.
9. Old and Primrose, ***Principles of Gene Manipulations.***
10. Watson, J.D., Gilman, M., ***Recombinant DNA Technology***
11. Baxevanis, A.D., Frana, Duelette, B.F.,***Bioinformatics***
12. Alberts, B., Johnson, A., Lewin, J., Raff, M., Roberts, K., Walter, P., ***molecular biology of the cell***
13. Paul, W.E, ***Fundamentals of Immunology***
14. Klug, W.S., Cummings, M.R., ***Essentials of Genetics***
15. Glick, B.R., Pasternak, J.J., ***Molecular Biotechnology***
16. Walker, J.M., Ripley, R., ***Molecular biology and Biotechnology***
17. Bolton, S***., Pharmaceutical Statistics.***

MODERN ANALYTICAL TECHNIQUES

Theory

1. Theory, Instrumentation, Methods and Applications of VU Spectrophotometer.
2. Theory and Instrumentation of IR and FT-IR, its advantage and applications in Structural elucidation.
3. NMR, C^{13} NMR, Origin of spectra, Chemical shifts, Spin-spin coupling, Coupling constant, Instrumentation and application for Structural elucidation.
4. Mass spectra, Instrumentation, Fragmentation pattern and applications for Structural elucidation. Application of GC-Mass, HPLC-Mass for complex mixtures.
5. Theory, Instrumentation and application for the following:
   - i) Fluorescence
   - ii) X – Ray crystallography
   - iii) Atomic spectroscopy
   - iv) Ultra centrifugation
   - v) ESR
   - vi) Liquid Scintillation spectrometry
   - vii) Auto radio grapy
6. Separation Techniques; Fundamental principles, Basic instrumentation, Qualitative and Quantitative Pharmaceutical applications of Gas-liquid Chromatography, HPLC, HPTLC, Gel Chromatography, Electrophoresis and Ion-pair Chromatography.
7. General Principle, instrumentation and application of optical rotatory dispersion (ORD) and Circular dichroism (CD).
8. Immunoassay Techniques: Enzyme and Radioimmunoassay techniques. Theory, Methods and applications.
9. Thermal methods: Thermo Gravimetry (TG), Differential Scanning Calorimetry (DSC), Differential Thermal Analysis (DTA).
10. Principles and application of light, Phase contrast, Scanning and Transmission electron microscopy, Cytometry and Flow cytometry.

Books and References Recommended:

1. Florey**, Analytical Profiles of Drugs**, Vol.1-16.
2. Sinder, **Text Book of HPLC.**
3. McLafferty**, Mass Spectrometry.**
4. Rao,C.N., **Ultraviolet Visible Spectroscopy for Chemical Application**.
5. Silverstein, Basseler, Morril, **Spectophotometrc Identification of Organic Compounds.**
6. Rao,C.N., **Chemical Application of Infrared Spectroscopy.**
7. Weissberger, **Physical Methods in Organic Chemistry.**
8. Kiencz, B. and Dierasi, C., **Interpretation of Mass Spectra of Organic Compounds.**
9. Jackmann, **Application of NMR Spectra to Organic Compounds.**
10. Willard, Merrit and Dean, I**nstrumental Methods of Analysis.**
11. Elliel, E.L., **Stereochemistry of Carbon Compounds.**
12. Naahod, P., **Physical Methods of Structure Determination**.
13. Stahl, **Thin Layer Chromatography**.
14. Ewing, **Instrumental Methods of Chemical Analysis.**
15. Block and Durrum, **Paper Chromatography and Electrophoresis**.
16. Remington's **Pharmaceutical Sciences.**
17. Sirmer, **Spectroscopic Analysis.**

PRODUCT DEVELOPMENT AND FORMULATION

Theory

1. **Preformulation studies:** Study of physical, chemical and pharmaceutical factors influencing formulation of drugs.
2. **Formulation additives:** Study of formulation additives, Drug – Excipient, Excipient - Excipient interactions and Incompatibilities.
3. **Solubilization:** Theory of solubilization, methods of solubility enhancement and factor influencing solubility. Solids dispersion.
4. **Dissolution Technology:** Design of dissolution apparatus, dissolution media, dissolution testing of different types of dosage formulations, data interpretation, *in-vitro* and *in-vivo* correlation**.**
5. **Tablets:** Recent advances in tablet technology and automation in manufacturing process, formulation and evaluation of dispersible, effervescent, floating and multilayers tablets.
6. **Formulation consideration and evaluation:** Parenterals and Ophthalmics.
7. **Polymers:** Classification, General method of synthesis, Properties, Characterization, Evaluation and Application in pharmacy. A detail account of biodegradable polymers.
8. **Nutraceuticals:** Introduction, formulations, uses, recent developments and law governing nutraceuticals.
9. **Pharmaceutical packaging:** Packaging materials, type and tests of containers and closures, Pilot plant scale up technique.
10. **Drug stability:** Stability study programmes for formulations. Determination of Expiry date (shelf life) and Overage calculations. Stability indicating assays and ICH guidelines for stability.
11. **OptimizationTechniques:** Computers in pharmacy, Optimization techniques, Computer aided drug formulations.

Books and References Recommended:

1. Swarbrick, J. and Boyran, J. C., **Encyclopedia of Pharmaceutical Technology"** Vol.1-3, Marcel Dekkar, Inc., New York.
2. Gennaro, A.R., Remington's "**The Science and practice of Pharmacy",** Lippincot, Wiliams & Wilkins, Philadelphia.
3. Aulton, M.E., "**Pharmaceutics- The science of doses form design",** Churchill Livingstone, London.
4. Carstersen, J.T., "**Drug stability: Principal & practice**", Marcel Dekker, Inc., NY
5. Banker and Rhodes, ***Modern Pharmaceutics.*** Marcel Dekker Inc. NY.
6. Liium, L. and Davis, S.S.**, "Polymers in controlled drug delivery", Wright Bristol.**
7. Kibbe**, " Hand book of Pharmaceutical Excipients.,** Pharmaceutical Press, London.
8. Lachmen, L. & Lieberman, H.A**., "Theory *and Practice of Industrial Pharmacy"*,** Verghese publishing house, Bombay.
9. Martin**, *Physical Pharmacy*.**
10. Lieberman, H.A. & Lachmen, L**., "Pharmaceutical Dosage forms –Dispersed Systems''** Vol.1-3 ,Marcel Dekker, Inc., NY.
11. Avise, K. E. & Lachmen, L., **"Pharmaceutical Dosage forms –"Parenteral Medications''** Vol.1-3 ,Marcel Dekker, Inc., NY.
12. Lieberman, H.A. & Lachmen, L**., "Pharmaceutical Dosage forms –Tablets''** Vol.1-3 ,Marcel Dekker, Inc., NY.
13. Yalkowsky,S.H." **Techniques of Solubilization of drugs**"**,** Marcel Dekker, Inc., NY.

First Year 2nd Semester

ADVANCED MEDICINAL CHEMISTRY

Theory

1. Theoretical basis of newer drug delivery systems; Prodrug, Dendrimer and Polymers as carrier.
2. Receptors – theories, Drug – Receptor interactions drug target binding forces Ion Channels: Structure function and Pharmacology.
3. Enzyme inhibition: Rational design based on inhibition kinetics, types, Affinity-labeling agents.
4. Classification, biomacromolecular study, mode of action, SAR, side effects, biological evaluation & recent advances in research of the following category of drugs.
    a) Antineoplastics
    b) Immunosupressants
    c) Antiviral and Anti HIV
    d) Antiprotozoal
    e) NSAIDS
    f) Antihyperlipidemic Drugs
    g) Antihypertensive
    h) Antiparkinsonism
    i) Antialzheimer Drugs
5. Combinatorial Chemistry: Introduction, Method of Synthesis and application.

Books and References Recommended:

1. Patrick. G.L, **An Introduction to Medicinal Chemistry.**
2. Burger,A., **Medicinal Chemistry.**
3. Wilson and Gisvold, **Organic Medicinal Pharmaceutical Chemistry.**
4. Ariens, **Drug Design**, Academic Press, New York, 1975.
5. Schueler, **Chemobiodynamic and drug design**.
6. Namstern, **Drug Interaction.**
7. Swidler, **Hand Book of Drug Interaction.**
8. Purcel,Basis and Clayton, **A Guide to Biological Activity.**
9. Foye, **Principles of Medicinal Chemistry.**

ADVANCED ORGANIC CHEMISTRY

Theory

1. Stereo Chemistry:
    a) Optical activity and Chirality, Racemic modification, Nature, Formation, Properties and Resolution criteria of optical purity.
    b) Asymmetric carbon atom: Newer methods of asymmetric synthesis (including enzymatic and catalytic synthesis), Enentio selective and Stereo selective synthesis.
    c) Stereochemistry of ring system. Stereoisomerism, Stability and ease of ring formation.
    d) Effects of conformation on reactivity in acyclic and cyclohexanes.
2. Formation and stability of Carboanion, Carbocation, Free radical, Carbenes and Nitrenes.
3. Mechanism of Oxidation, Reduction and Hydrolysis.
4. Uses of the following reagents and catalysts in organic synthesis.
    i) Ruthenium tetroxide, Nickel peroxide, Caro's reagent, Lemieuxvon-Rudloft reagent, Jones reagent, Corey's reagent and Collins reagent.
    ii) Borane in THF, $AlCl_3$ in THF, $NaAlEt_2H_2$, Pd, $LiAlH_4$,
    iii) Ziegler – Natta catalyst, Wilkinson catalyst, Glimann reagent,
    Dicyclohexyl Carbodimide and phase transfer catalyst.
5. Reaction Mechanism and method of determining them, Aliphatic nucleophilic (SN1, SN2, SN'1, SN'2) and Aromatic nucleophilic substitution (SNAr and benzyne mechanism) reactions.
6. Neighboring group participation and non-classical carbonium ions. Selection rules and stereochemistry of Electrocyclic reactions, Cyclo addition and Sigmatropic shifts.
7. E1 and E2 mechanism, Hoffmann and Saytzeff like elimination reactions.
8. Effects of structure on reactivity.
9. Rearrangement reactions: Fries, Stobbe, Hauser, Cope, Pummierer, Pinacol-Pinacolone, Arandt-Eistert, Benzil-Benzylic acid, Hoffmann, Curtius, Lossen, Schimidt, Beckmann, Bayer–Villiger and Claisen.
10. Dakin reaction, Reformatskey, Chichibabin reaction, Birch reduction, Wittig reaction, Oppensuer oxidation, Ozonolysis and Jourdan Ullmann reaction, Stork enamine reaction, Ene reaction, Barton reaction, Shapiro reaction.
11. Hydrogenation of Double, Triple and Aromatic rings.

Books and References Recommended:

1. Mukerjee,S.S. and Singh,S.P**., Reaction and Mechanism in Organic Chemistry.**
2. Peter Sykes, **A Guide Book of Reaction Mechanism in Organic Chemistry.**
3. Jerry March, **Advanced Organic Chemistry.**
4. Elial, E.L., **Stereochemistry of Carbon Compounds.**
5. Finar, **Organic Chemistry**, Vol. 1 & 2.
6. Solomons, G.T.W., **Organic chemistry.**
7. Morrison and Boyd, **Organic Chemistry.**

Advanced Pharmaceutical Chemistry

1) **Techniques involved in Extraction isolation & Standardization with Specific reference to herbal products**
   - Supercritical fluid extraction
   - Solid phase micro extraction
   - H P TL C
   - Electro chromatography
   - Mass spectrometry

2) **Basic Metabolic pathways for production of secondary metabolites-**
   - Acetate pathway
   - Shikimate pathway
   - Mevalonate pathway

3) **Biosynthesis-**
   - Tropane alkaloids
   - Adrenocorticoids
   - Sex harmones
   - Peptides and their derivatives viz. Thyroid hormones, Oxytocin, Insulin, Penicillin, cephalosporin and clavulanic acid.
4) **Isolation and Phytochemical studies of some important constituents in -**
   - Digitalis glycosides
   - Senna glycosides
   - Cinchona alkaloids
   - Rawolfia alkaloids
   - Ergot alkaloids
   - Taxal
5) **Principles and application of Tracer techniques in biology.**
6) **Constitution and applications of Thyroid hormones, Oxytocin and Insulin.**
7) **Isolation from microorganisms and Chemistry of Antibiotic special references to Macrolide, Beta lactum and amino glycoside antibiotics.**

Books and References Recommended:

1. Trease and Evans, ***Textbook of Pharmacognosy*.**
2. Elial, E.L., ***Stereochemistry of Carbon Compounds***.
3. Fieser,I.E. and Fieser,M., ***Steroids.***
4. Burger,A., ***Medicinal Chemistry*.**
5. Wilson and Gisvold, *Organic* ***Medicinal Pharmaceutical Chemistry.***
6. Malentyeva,G. and Antonova,L., ***Pharmaceutical Chemistry.***
7. Finar, ***Organic Chemistry,*** *Vol. 2.*
8. Schueler, ***Chemobiodynamic and drug design***.
9. Namstern, ***Drug Interaction.***
10. Dewick, P.M**., Medicinal natural Products.**
11. Purcel,Basis and Clayton***, A Guide to Biological Activity.***
12. Foye***, Principles of Medicinal Chemistry.***

DRUG DESIGN

1. **Introduction to Drug Design & Discovery –** Historical perspective, Generation of leads & lead optimization, Cell Biology & Genomics as a source of Drugs, future developments in the drug design.
2. **Molecular Recognition in Drug Design –** Introduction, Thermodynamic considerations of Drug design, Physical basis of intermolecular interactions, total energy intermolecular interaction, estimating individual group components in ligand receptor interactions and co-operativity and thumb rules.
3. **Stereochemistry and drug design –** Stereospecificity in molecular recognition, Significance of stereochemistry in drug design, Methods of obtaining pure stereoisomers, Analytical methods of determining purity of stereoisomers.
4. **Bioisosterism in drug design**.
5. **Three dimensional aided drug design** – structure aided drug design process, methods to derive 3D structures., Design process, software aided drug design, optimization of identified compounds, example of structure aided drug design.
6. **Computer Aided Drug Design – Pharmacophoric approach:** Pharmacophore based ligand design, pharmacophore concept, Pharmacophore elements and representation, active conformation, molecular superimposition, receptor excluded and receptor essential volumes, solvation effects, examples of 3D pharmacophore models and their use.
7. **Quantitative Structural Activity Relationships (QSAR):** Fundamentals of QSAR, Biological data, the additivity of group contribution Hansch analysis and related approaches, physicochemical properties, Statistical methods in QSAR, application of Hansch and related approaches, 3D QSAR approach.
8. **Molecular modeling** – Generation of 3D coordinates, Sketch approach, conversion of 2D structure in 3D form, force field, geometry optimization, energy minimizing procedures, Quantum mechanical methods, conformational analysis, pharmacophore identification, molecular modeling in 3D QSAR – CoMFA and related methods.
9. **Nucleic Acid Based Drug Design**: Structure, Protein-nucleic acid interaction, Drug-nucleic acid interaction.

Books and References Recommended:

1. Burger,A., **Medicinal Chemistry.**
2. Wilson and Gisvold, **Organic Medicinal Pharmaceutical Chemistry**.
3. Ariens, **Drug Design**, Academic Press, New York, 1975.
4. Schueler, **Chemobiodynamic and drug design**.
5. Foye, **Principles of Medicinal Chemistry.**
6. Solkovisky, Sinkula and Valvani, **Physicochemical Properties of Drugs**, Marcel Deeker, Newyork, 1980.
7. Martin, Y., **Quantitative Structural Activity Relationships**, 1978.
8. Hansch, **Principles of Medicinal Chemistry**.
9. Kubiny's, **Quantitative Structure Activity Relationships**.
10. Holtje, Sippl, Rognan and Folkers, **Molecular Modeling.**