INSTITUTE OF CHEMICAL TECHNOLOGY

(Deemed to be University under section 3 of the UGC Act 1956)

Detailed Syllabus for First Year M. Pharm Medicinal Chemistry

Sr. No.		Hrs
	Core Subjects	
1.	**PYT 2106– Physical Methods of Analysis (50 marks) 3hr./week**	
	Fourier Transform Infrared Spectroscopy: Molecular Vibrations, Frequency shifts associated with structural changes; Basic theory of FTIR spectroscopy, inteferogram, digitization of interferogram, data points collection; Instrumentation and advantages of FTIR spectrophotometry; Qualitative and quantitative analysis using infrared spectrophotometry.	
	Ultraviolet and Visible Spectrophotometry: Electronic transition, spectrum, shift of bands with solvents, isolated double bonds, conjugated dienes, carbonyl compounds, aromatic and heteroaromatic compounds; Application in pollution control and chemical industry.	
	Nuclear Magnetic Resonance: Basic principle of NMR phenomenon, relaxation processes, spin-spin interaction, chemical shifts, interpretation of NMR spectra, correlation-hydrogen bonds to carbon and other nuclei; Instrumentation-Continuous and pulsed NMR, carbon- 13NMR.	
	X-ray Diffraction: Crystal geometry and structural determination; Bragg law of X-ray diffraction, powder method; X-ray spectrometers-wide and small angle diffractrometers; Chemical analysis by X-ray diffraction.	
	Particle Size Analysis: Particle size, sampling, conventional techniques of particle size measurement, light scattering particle size measurement by light scattering techniques; Dynamic light scattering (DLS), fibre optic dynamic light scattering (FDLS).	
	Chromatography: Basic theory of separation, efficiency, resolution; Liquid chromatography, high performances liquid chromatography; Gas chromatography-columns and detectors; Qualitative and quantitative analysis.	
	Mass spectroscopy: Basic principle, ionization of a molecule on electron impact, fragmentation processes in organic compounds, interpretation of mass spectra, molecular weight, molecular formula; Instrumentation-different types of ionization sources and magnetic analyzer.	
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2.	**PHT 2201– Advance Organic Chemistry – I (50 marks) 3hr./week**	
	Recapturing(This is only to refresh the organic chemistry studied so far and which is relevant to subsequent topics): Synthetic Methodologies Frequently used in drug synthesis with emphasis on recent developments in oxidation,	2

	reduction, carbon-carbon bond forming reactions including organometallic and palladium based methods, Protection and deprotection methods.	
	Current trends in synthetic methodologies including use of microwave, sonication, ionic liquids, reaction in absence of solvents and concept of green chemistry with illustrative examples of green synthetic methodologies	6
	Retrosynthetic analysis and design of synthetic route and suggession of approximate reaction conditions: i.concept, synthon-regents, FGI, Building block based strategies with illustrative exampes of drugs of current interests ii. Retros-ynthetic analysis with construction of a) carbo-cycles (three, five, and six membered rings using classical methods and latest methods such as metathesis reactions) b) heterocyclic rings of pharmaceutical interests with examples of drug synthesis	15
	Asymmetric synthesis; fundamental principles, asymmetric induction, discussion of classic methodologies	3
	Discussion of any four classic total syntheses of bioactive natural products.	4
	• Advanced Organic Chemistry, 4th Ed., Parts A and B, Carey F. A and Sundberg, R.J.,; Chirotechnology, industrial synthesis of optically active compounds, Sheldon R.A.; Textbook of Drug Design and Discovery, Krogsgaard-Larsen P, Liljefors, T, Madsen U; Advanced Organic Chemistry, March J.; Combinatorial Chemistry: Synthesis and Applications, Wilson S. R. and Czamik A; Organic Synthesis, The disconnection Approach, Warren S; Synthon Approach , Iyer R.P et.al., Organic Chemsitry, J. Clayden; The Logic of Chemical Synthesis, E.J. Corey; Classics in Total Synthesis, K.C. Nicolou and E.J. Sorensen.	
3	**PHT 2202 – Advanced Medicinal Chemistry – I (50 marks) 3hr./week**	
	Introduction to Historical and Modern Drug Discovery- Sources of drugs/leads • Serendipity, random screening, natural sources, molecular modification • Lead optimization • Rational drug design	5
	Techniques and tools in modern drug discovery Introduction to QSAR, SBDD and LBDD	2
	Molecular Mechanics • General features of force fields, cross terms, force field parameterization • Energy minimization – non-derivative and derivative methods, applications of energy minimization • Techniques of searching the conformational space – systematic search, Monte Carlo, Molecular dynamics and distance geometry	8
	2D-QSAR • History and development of 2-D QSAR • Parameters – lipophilicity and related parameters, electronic parameters, steric parameters, other parameters	10

	• Quantitative models – Hansch approach, Free Wilson analysis, the mixed approach • Statistical methods – regression analysis, partial least square and other multivariate statistical methods • Design of test series in QSAR-Some examples of Hansch and other methods	
	Physico-chemical properties of drugs and their importance in drug discovery • Lipinsky rule of 5 • Concept of toxicophores • Insilico calculation of log P, log D values • Modification of leads to incorporate suitable ADMET properties. Examples to be taken as case studies from recent literature.	5
	• Burger's Medicinal Chemistry, Drug Discovery and Development. 7th Edition Volume 1-9. By Donald J. Abraham, David P. Rotella. August 2010. • Comprehensive Medicinal Chemistry, Series Ed. Hansch C., Vols 1-5, Pergamon Press. • 3D QSAR in Drug Design: Theory, Methods and Applications, Kubinyi H Ed., Leiden ESCOM, 1993. • Molecular Modelling – Principles and Applications, Andrew R Leach, 2nd Ed., Prentice Hall, 2001. • Practical Application of Computer-Aided Drug Design, Paul S Charifson, Ed., Marcel Dekker, Inc., 1997. • Reviews in Computational Chemistry, Lipkowitz K.B. and Boyd D.B. Eds, VCH Publishers, N.Y. • The Organic Chemistry of Drug Design and Drug Action, Richard Silverman, 2nd Edition, 2004. • Pharmacokinetic Optimization in Drug Research: Biological, Physicochemical, and Computational Strategies Bernard Testa, Han van de Waterbeemd, Gerd Folkers, Richard Guy January 2002. • Essentials of Computational Chemistry: Theories and Models Cramer, C.J. John • Textbook of Drug Design and Discovery, Povl Krogsgaard-Larsen, Ulf Madsen, Kristian Stromgaard, 4th Edition, 2009. Taylor and Francis. • Antitargets: Prediction and Prevention of Drug Side Effects, Roy J. Vaz, Thomas Klabunde, Raimund Mannhold, Hugo Kubinyi, Gerd Folkers March 2008. • Analogue-based Drug Discovery I and II, Janos Fischer C. Robin Ganellin August 2010. • Chemogenomics in Drug Discovery: A Medicinal Chemistry Perspective, Hugo Kubinyi, Gerhard Müller, Raimund Mannhold, Gerd Folkers October 2004. • Chemoinformatics in Drug Discovery by Tudor I. Oprea, Raimund Mannhold, Hugo Kubinyi, Gerd Folkers, May 2005.	

	• Combinatorial Chemistry and Molecular Diversity in Drug Discovery, Eric M. Gordon, James F. Kerwin August 1998. • Computational Drug Design: A Guide for Computational and Medicinal Chemists, by D. C. Young February 2009.	
4	**Elective-I (50 marks) 3hr./week**	
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5	**Elective-II (50 marks) 3hr./week**	
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6	**PHT 2101– Research Methodology (50 marks) 3hr./week**	
	Research 1. Meaning of Research, Purpose of Research, Types of Research (Educational, Clinical, Experimental, Historical, Descriptive, Basic applied and Patent Oriented Research) – Objective of research- 2. Literature survey – Use of Library, Books, & Journals – Medline – Internet, getting patents and reprints of articles as sources for literature survey. 3. Selecting a problem and preparing research proposal for different types of research mentioned above. 4. Methods and tools used in Research • Qualitative studies, Quantitative Studies • Simple data organization, Descriptive data analysis • Limitations and sources of Error • Inquiries in form of Questionnaire, Opinionnaire or by interview • Statistical analysis of data including variance, standard deviation, students 't' test and annova, correlation data and its interpretation, computer data analysis, 5. Documentation • "How" of Documentation • Techniques of Documentation • Importance of Documentation • Uses of computer packages in Documentation 6. The Research Report / Paper writing / thesis writing • Different parts of the Research paper 1. Title – Title of project with author's name 2. Abstract – Statement of the problem Background list in brief and purpose and scope 3. Key-words- 4. Methodology-Subject, Apparatus / Instrumentation, (if necessary) and procedure 7. Results – tables, Graphs, Figures, and statistical presentation 8. Discussion – Support or non- support of hypothesis – practical & theoretical implications, conclusions 9. Acknowledgements	

	10. References 11. Errata 12. Importance of spell check for Entire project 13. Use of footnotes	
	<u>Presentation (Specially for oral)</u> • Importance, types, different skills • Content of presentation, format of model, Introduction and ending • Posture, Genstures, Eye contact, facial expressions stage fright • Volume- pitch, speed, pauses & language • Visual aids and seating • Questionnaire	
	<u>Protection of patents and trade marks, Designs and copyrights</u> • The patent system in India – Present status Intellectual property Rights (IPR), Future changes expected in Indian Patents • Advantages • The Science in Law, Turimetrics (Introduction) • What may be patented • Who may apply for patent • Preparation of patent proposal • Registration of patent in foreign countries and vice-versa	
	<u>Sources for procurement of Research Grants</u>	
	<u>Industrial- Institution Interaction</u> - Industrial projects – Their feasibility reports	
	• Research in Education – Johan V. Best James V. Kahn • Presentation skills- Michael Halton- Indian Society for Institute Education • A Practical Introduction to copy right – Gavin Mcfarlane • Thesis projects in Science and Engineering – Richard M. Davis • Scientists in legal system – Ann labor science • Thesis and Assignment writing – Jonathan Anderson • Writing a technical paper- Donald Menzel • Effective Business Report writing – Leland Brown • Protection of Industrial property rights- Purushottam Das and Gokul Das • Spelling for the million – Edna furmess • Preparing for publication – King Edwards Hospital fund for London • Information technology – The Hindu speaks • Documentation – Genesis & Development 3792 • Manual for evaluation of Industrial projects – United Nations • Manual for the preparation of Industrial feasibility studies	
7	**PHT 2206– Advanced Pharmaceutical Chemistry (50 marks) 3hr./week**	
	Solid phase synthesis: Concept, resins, linkers, characterizations, examples. Peptide synthesis: Protected amino acids, coupling agents, strategies in	5 7

	synthesis with examples of peptide drugs and hormones. Solid phase synthesis and peptide synthesizers. Oligonucleoside Synthesis: Methodologies, solid phase oligonucleosides synthesis. Combinatorial synthesis: liquid phase and solid phase, deconvolution techniques, design of libraries, these to be discussed with illustrative examples of combinatorial libraries. Organic nanomaterial(Single molecular and molecular assemblies): Design, synthetic strategies, characterisation and properties. E.g. dendrimers, polymeric nanomaterials, carrier-systems for drug targeting. Fluorescent and imaging materials: Design and synthesis, properties and applications.	3 7 5 3
	• Advanced Organic Chemistry, 4th Ed., Parts A and B, Carey F. A and Sundberg, R.J.,; Chirotechnology, industrial synthesis of optically active compounds, Sheldon R.A.; Textbook of Drug Design and Discovery, Krogsgaard-Larsen P, Liljefors, T, Madsen U; Advanced Organic Chemistry, March J.; Combinatorial Chemistry: Synthesis and Applications, Wilson S. R. and Czamik A; Organic Synthesis, The disconnection Approach, Warren S; Synthon Approach , Iyer R.P et.al., Organic Chemsitry, J. Clayden; The Logic of Chemical Synthesis, E.J. Corey; Classics in Total Synthesis, K.C. Nicolou and E.J. Sorensen.	
8	**PHT 2204– Spectroscopy-I (50 marks) 3hr./week**	
	Problems in structure determination using an integrated approach 1. Application of UV in structure determination 2. Application of IR in structure determination 3. Application of NMR in structure determination 4. Application of MS in structure determination 5. Problems based on the integrated approach of the four spectroscopic techniques of UV, IR, NMR and MS.	 2 2 8 4 14
	• Applications of Absorption Spectroscopy of Organic Compounds, John R Dyer; Organic Structural Spectroscopy, Lambert, J.B., Shurvell H.F., Lightner D.A. and Cooks R.G.; Structure Elucidation by Modern NMR, Duddeck H. and Dietrich W., Steinkopf ; Mass Spectrometry, Principles and Applications, Williams D.H. and Bowen R.; Spectroscopic Idetification of Organic Compunds, R.M. Silverstein, G.C. Basslrer, T.C. Morrill; Carbon-13 NMR spectroscopy, E. Breitmeir and W. Voelter.	
9	**PHT 2205– Advanced Medicinal Chemistry – II (50 marks) 3hr./week**	
	Applications of Molecular modeling in drug design- A. Docking by - Energy minimization - Superimposition - Molecular dynamics - Metropolis Monte Carlo	4

	- Monte Carlo minimization - Genetic algorithms - Distance geometry - Build up approach Examples from literature and available programs B. De Novo and fragment based ligand design • Classes of De Novo ligand design – active site analysis methods, whole-molecule methods, connection methods and random connection and disconnection methods. • Fragment based drug design e.g. from literature and programs available to be discussed. C. Pharmacophore modeling • Difficulties in deriving a 3D-pharmacophore • Techniques – constrained systematic search, ensemble distance geometry, ensemble molecular dynamics and genetic algorithms • Incorporating additional geometric features into a 3D pharmacophore • 3D database searches for pharmacophores. D. 3D-QSAR approaches • CoMFA and CoMSIA, brief discussion on other methods like MSA, RSA and HASL methods Limitations of QSAR. E. Molecular diversity in drug discovery	3 3 4 1
	A. Drugs acting by enzyme inhibition Protease inhibitors – ace inhibitors and renin inhibitors, reductase inhibitors – HMG-Co reductase inhibitors, HIV-reverse transcriptase, protease and integrase inhibitors, cyclooxengase, leukotrienes and lipoxygenase inhibitors, aromatase inhibitors and DHFR inhibitors. B. Rational drug design of enzyme inhibitors Two to three case studies with inputs from molecular drug design/combinatorial chemistry.	5 4
	Receptors and drug design A. 3D structure of examples of GPCR and PDE receptors with emphasis on functional mapping of ligand binding sites. B. Two to three case studies with inputs from molecular drug design/combinatorial chemistry.	3 3
	• All references in Advanced Medicinal Chemistry I • Enzymes, Dixon M and Webb E. C., 3rd Ed., Longman Group Ltd., 1979. • Lehninger, Principles of Biochemistry, Nelson D. L. & Cox M.M, 3rd Ed., Replika Press Pvt. Ltd., India, 2000 • Biochemistry, Stryer L, 3rd Ed. W.H. Freeman & Co,. N.Y, 1988. • Handbook of Drug Screening, Seethala R & Fernandes P.B., No. 114, Drug and Pharmaceutical Sciences – A series of Textbooks and Monographs, Marcel Dekker, N.Y. and Basel, 2001. • Textbook of Drug Design and Discovery, Povl Krogsgaard-Larsen, Ulf Madsen, Kristian Stromgaard, 4th Edition, 2009. Taylor and Francis.	

	• Cell Surface Receptors: A Short Course on Theory and Methods, Limbird, L.E., Nijhoff, Boston, 1986. • Drug Development, Hamner C. E., Ed., 2nd Ed., CRC Press, Boca Raton, 1990. • Pharmacologic Analysis of Drug-Receptor Interaction, Kenakin, T.P., Raven, N.Y., 1987. • Principles in General Pharmacology, Tallarida, R.J., Raffa, R.B. and McGonigle P., Springer-Verlag, N.Y., 1988. • Receptor Pharmacology and Function, Williams, M., Glennon, R.A. and Timmermans P.B.M.W.M, Eds, Marcel Dekker, N.Y., 1988.	
10	**Elective-III (50 marks) 3hr./week**	
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11	**Elective-IV (50 marks) 3hr./week**	
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12	**PHP 2501– Critical Review of One Research Publication (50 marks) 3hr./week**	
13	**PHP 2502– Seminar (50 marks) 3hr./week**	
14	**PHP 2503– Literature Review of the proposed research topic (50 marks) 3hr./week**	
Elective Subjects		
15	**PHT 2001 – Biopharmaceuticcs and Pharmacokinetics (50 marks) 3hr./week**	
	Biopharmaceutics	
	1. Introduction: Recap of ADME, bioavailability, bioequivalence and factors affecting the same	**1**
	2. Molecular basis of drug Absorption & transport ▪ The Molecular structure and nature of the cell membranes & nuclear membranes ▪ Transcellular absorption 1. Nature of passive transcellular absorption 2. Carriers for the active transport of drugs (With special emphasis on p-glycoprotein & design of pgp inhibitors) 3. Methods of studying the carrier mediated transport ▪ Paracellular absorption 1. The molecular organization of the paracellular space	**9**

	2. The regulation of paracellular permeability 3. Methods of studying the paracellular absorption ▪ Penetration enhancers & study of their molecular mechanisms of action ▪ Drug delivery to cell organelles 1. Extracellular barriers 2. Intracellular barriers Study of cell penetrating peptides and fusogenic peptides and their applications in drug delivery	
	3. Drug Membrane interactions ▪ Possible effects of drugs on the membranes & effect of membrane on drugs ▪ Role of drug membrane interaction in pharmacokinetics & pharmacodynamics of drugs ▪ Development of predictive models for drug membrane interactions (in vitro & computational) ▪ Study of the drug membrane interactions	**3**
	4. Pharmacogenomics ▪ Genetic basis of variation of pharmacokinetics ▪ Methods for pharmacogenomic profiling & study	**2**
	Pharmacokinetic	
	Introduction to ADME and basic pharmacokinetic parameters like Volume of distribution, Elimination half life, Elimination rate constant, Clearance, Area under curve, Bioavailability, calculation of parameters from plasma and urine data	**2**
	Role of Pharmacokinetics in drug discovery; drug development and process development;	
	Mathematical approach to pharmacokinetic modeling; one-compartment open models and data analysis; multiple-dose pharmacokinetics; two-compartment open models; physiological pharmacokinetic models; nonlinear pharmacokinetics; metabolite pharmacokinetics; pharmacokinetic-pharmacodynamic modeling, Case studies and problem solving w.r.t. above including design of controlled release dosage forms and other novel drug delivery systems based on pharmacodynamic and pharmacokinetic rationale.	**9**
	In-vitro-In-vivo correlation	**2**
	Individualization of dosage regimen, conversion from IV dosing to oral dosing, determination of dose, frequency of administration and route of administration, therapeutic drug monitoring, dosing of drug in infants and elders, variability in clinical response and pharmacokinetics w.r.t. renal and hepatic diseases.	**2**
16	**PHT 2002– Intellectual property Rights and Patent Filing (50 marks) 3hr./week**	

	1. Introduction to IP 2. Copyright, Related Rights, Trademarks, Geographical Indications, Industrial Design 3. Patents 4. WIPO Treaties 5. Unfair Competition 6. Protection of New Varieties of Plants 7. Summary and Discussion on IP Rights	2 5 15 2 2 2 2
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17	**PHT 2003 – Advanced Biochemistry (50 marks) 3hr./week**	
	Proteins: Structures – primary, secondary, tertiary, motifs, structural and functional domains, protein families and macromolecular assemblies.	4
	Mechanisms for regulating protein function: Protein-protein interactions, interaction with ligands, Ca^{+2} and GTP as modulators, cyclic phosphorylation and dephosphorylation, proteolytic cleavage	4
	Purification and characterization of proteins: Electrophoresis, ultracentrifugation and liquid chromatography, use of biological assays, use of radioisotopes and MS, X-ray crystallography, NMR and Homology modeling, amino acid analysis, cleavage of peptides, protein sequencing.	4
	Protein biosynthesis:Translation machinery in prokaryotic and eukaryotic systems, comparison of similarities and differences.	4
	DNA and nucleic acids:DNA, RNA structure, nomenclature, double helix, conformations, higher order packing and architecture of DNA, transcription and replication of DNA – mechanisms in prokaryotic and eukaryotic systems, DNA repair mechanisms.	6
	Carbohydrates: Mono, di and polysaccharides and their nomenclature, stereochemistry, linkages, conjugates of carbohydrates with other molecules - glycoproteins, glycolipids, proteoglycans, lipopolysaccharides and their biological roles.	4
	Lipids: Classification, nomenclature, stereochemistry, storage lipids, membrane lipids, lipids as second messengers and cofactors, biological role of lipids	4
	• Lehninger Principles of Biochemistry, Lehninger and Nelson D. L.; Biochemistry, Stryer L.; Molecular Cell Biology, Lodish H. and Darneu J.	
18	**PHT 2004– Drug Metabolism (50 marks) 3hr./week**	
	Introduction to the different pathways of drug metabolism: Phase I and II reactions, sites of drug metabolism, subcellular localization of drug metabolizing enzymes, cofactors required for catalytic reactions	7
	Cytochrome P450 oxidative system: Catalytic cycle of P450 reactions, mechanism of P450 hydroxylation reactions, introduction to CYP450 superfamily of enzymes and their classification, human CYP450s involved in drug metabolism and their typical substrates, inhibitors and inducers.	7
	Introduction to other drug metabolism enzyme isoforms/families Glucuronosyltransferases, glutathione transferases, sulfotransferases, N-	10

	acetyltransferases, FMO's.	
	Methods for studying drug metabolism: Isolated enzymes, recombinant enzymes, subcellular fractions, hepatocytes, perfused liver, in-vivo drug metabolism studies – introduction to these methods, their utility, advantages and limitations	4
	Introduction to in-silico methods for predicting drug metabolism: Principles behind development of these systems, their potential and their limitations.	2
	• Foye's Principles of Medicinal Chemistry, William D.A and Lemke T.L., 5th Edition; Handbook of Drug Metabolism, Woolf T.F.; • Drug Metabolising Enzymes, Lee J.S., Obach S.R., Fisher M.B.; Cassaret • Doull's Toxicilogy, The Basic Science of Poisons, Klaasen C. D., Amdur M.O., and Adull J.; • Fundamentals of Drug Metabolism and Disposition, La Du B.N., Mandel H.L., & Way L.E.	
19	**PHT 2005 – Molecular Biology (50 marks) 3hr./week**	
	Introduction to recombinant DNA technology: Introduction to DNA and its functions, Replication of DNA and its transcription and translation, restriction enzymes and their properties, vectors for use in rDNA technology, creation and introduction of rDNA molecules, cloning and expression of rDNA molecules, cloning and expression systems, their advantages and limitations, application of rDNA technology in production of pharmaceutical and in drug discovery and development.	14
	High throughput screening: Introduction to the principles of screening and the philosophy of HTS, considerations in HTS method development, validation of HTS methodology, some examples of typical HTS assays and the principles involved therein.	4
	Genomics/Proteomics: Introduction to the definitions of various 'omics', introduction to the general field of genomics and proteomics, introduction to some methods used in analyzing gene expression at the mRNA and protein level, basic principles of DNA/Protein microarrays and their applications.	6
	Human Genome Initiative:Introduction to the genome, genome complexity and genome organization, basic approaches towards sequencing of genomes, the approach for sequencing the human genome, sources for obtaining human genome sequence information, data mining of the human genome sequence for information and other potential applications, introduction to bioinformatics.	6
	• Molecular Biotechnology, Principles and Applications of recombinant DNA, Glick B. R. & Pasternak J.J.; Principles of Genome Analysis & Genomics, Primrose S.B. & Twyman R.M.; Gene Biotechnology , Jogdand S.N.; Biotechnology-Theory & Techniques, Gen Engg, Mutagenesis, Separation Technology, Chirirjian J G; Pharmaceutical Biotechnology – A introduction for Pharmacists & Pharmaceutical Scientists, Crommelin D.A. & Sindelar R. D.	
20	**PHT 2006 – Clinical Pharmacy (50 marks) 3hr./week**	
	Introduction to clinical Pharmacy	2

	- Scope, objectives and Goal in Health Care - Practice of Clinical Pharmacy in Hospitals and Community	
	Understanding the Patient - Pharmacist-Patient Interview - Interview Techniques, communication skills - Medication History, Habits related to the use of OTC medications, foods, allergies and sensitivities - Case Presentation	2
	Fundamentals of Diseases - Symptoms and Disease Identification – General Discussion - General and systemic effects of disease - Cardiovascular and other systemic effects of disease and injury - Endocrine and metabolic responses to disease and trauma - Nervous system involvement in disease - Ageing and geriatric diseases - Communicable disease prevention	10
	Therapeutic use of medicine - Drug selection and administration. Problems associated with concomitant therapy. Patient sensitivities, allergies. Precautions during use – Diet control. - Reasons for non-compliance – Poor standards of labeling, social isolation, complex therapeutic regimes, Nature of medication, side effects, lack of doctor / pharmacist/ patient rapport, inadequate patient education. - Strategies for improving compliance – Supplementary labeling, Simplification of therapeutic regimen, patient counseling, use of warning cards, patient education – patient package inserts. - Use of Drugs in geriatric paediatric patients and in pregnancy.	5
	Monitoring the patient in Health and illness - Fluid and Electrolyte Imbalance - Cardiopulmonary Dysfunction - Metabolic disorders - Patient follow-up-discharge interview for hospitalized patients. Precautions and directions during use of medications - Pharmacological and Biochemical examinations their significance - Supervisions of therapeutic success, side effects and adverse effects	4
	Drug Information - Introduction to information resource available. Development of drug information and drug information service. Drug literature utilization, selection, evaluation and communication. Physician-Pharmacist- Interactions Pharmacist-Patient-Interactions	4
	Investigational Drugs and Clinical Research	3

	Ethical and Legal Considerations in Evaluation of New Therapy Investigational Drugs- Research Design Bioequivalence and clinical trials of Drug substances – Brief Review	
	• Clinical Pharmacy Practice Ed. Charles W. Blissit Lea & Febiger Publications • Clinical Pharmacy and Hospital Drug Management ed Lawson and Richards • Clinical Pharmacy- Kleijn Elservier Press, Amsterdam • Applied Therapeutics for Clinical Pharmacists – Koda Kimble M. N. Applied therapeutics Inc, San Francisco • Drug Information for the Health Care Provider vol. I USP DI • Advice for the Patient Vol. II, USP DI • Handbook of Pharmacy Healthcare Diseases and Patient Advice Ed. R. J. Harman Pharmaceutical Press, London • Patient care in Community Practices -R. J. Harman Pharmaceutical Press, London	
21	**PHT 2007 – Packing Technology (50 marks) 3hr./week**	
	Its status and scope in Pharmaceutical Industry	1
	Classification of packaging material into primary and secondary packaging, functions of packaging.	2
	Primary Packaging Material: a. Glass containers (ampoules, vails and bottles) metals (tins for consmetic powders, tubes for skin and ophthalmic ointments, Aluminium containers and foils) 9 Fibers board and paperboard for bulk packaging in containers and drums). b. Containers and laminations of the metal containers Films and Foils- including AL, PVC, used ins trip packaging and blister packaging of tablets, cellulosics and cellophone. c. Plastic- polymers and copolymers, electrosetting and thermoforming (Medium and high density polystyrene PET) d. Equipment in primary packaging including strip packing, blister packing powder filling , liq filling, aerosol filling, snap on closures. e. Design and specification for he containers including bottles, thread, their dimensions and others.	5
	a. Secondary Packaging Materials: Folding cartons and set of boxes, Materials of construction, design and specifications-corrugated fiberboard, Packaging inserts- specifications and test methods and quality control. b. Cushioning – Cushioning materials, applications for impact, vibrations, temperature and humidity closures, applicatures fasteners and adhesives- cap threads, cap liners, aluminium bands, shrink brands, stoppers and plugs, tapes, adhesives. c. Shrink Warp Process	6

	Specifications, quality control tests and methods and evaluation of packaging of materials.	10
	Labels and labeling a. Direct printing heat transfer, ordinary labels, adhesives b. Standards and Quality Control test including dimensions printing and lists such as folding test, gluing, ageing, block vibration and shock for the boxes c. Toxicity and safety of printing inks	2
	Sterilization of containers: Different methods of sterilization for containers (primary) including autoclaving, dry heat, gas sterilization, ionizing and non-ionizing radiations	1
	Stability of packaging materials	2
	Law and regulation governing packaging	1
22	**PHT 2008 – Therapeutic Drug Monitoring (50 marks) 3hr./week**	
	Introduction to Therapeutic drug monitoring:- Definition and introduction, Historical background, Indication for Therapeutic drug monitoring, Monitoring plasma drug levels, Clinical application of Therapeutics drug monitoring, Role of Clinical pharmacist in Therapeutic drug monitoring.	2
	A. Techniques:- I) . Physical methods: II) Detailed study of different chromatographic techniques like- High Performance Liquid Chromatography (HPLC), High Performance Thin Layer Chromatography (HPTLC), Gas Chromatography (GC), Counter Current Chromatography (CCC) III) Immunoassays:- IV) Detailed study of following immunoassays:- Radio Immunoassay (RIA), Enzyme Multiplied Immunoassay Technique (EMIT), Fluoroscence Polarisation Immunoassay (FPIA), Enzyme Linked Immunosorbent Assay (ELISA), RPIA, Apoenzyme Reactivation Immunoassay System (ARIS), nephalometric Inhibition Immunoassay (NIIA), Substrate Labeled Fluoroscence Immunoassay (SLFIA), Prosthetic Group Labeled Immunoassay (PGLI). B. Critieria for selection of method for Therapeutic Drug Monitoring: I) Physical properties for drug molecule such as chemical structure present, Molecular weight, Pka Values, Melting and Boiling point, Drug Solubility Concentration range of compound. II) Characteristic of method like Level of Precision and accuracy required, complexity of the sample, Number of samples to be analysed, Time required for analysis, Specificity and sensitivity of the method, Cost of the method.	8 5
	Importance of Therapeutics Drug Monitoring with reference to Adverse Drug	1

	Reaction and Drug interaction.	
	Variation of Clinical Laboratory Tests due to drugs:- Test:- Serum creatinine, Blood Urea Nitrogen, Plasma Glucose, Creatine Kinase, Phosphatases, Amylase, Bilirubin, Serum Proteins, Globulin, Complete blood count and Gifferential Blood count.	2
	Therapeutic Drug Monitoring of specific drugs :- Clinical pharmacokinetics, General guidelines, Sample collection, Time of sample collection, Cilnical comments, Clinical monitoring parameters, Usual dosing parameters, Common toxicities, adverse drug reaction and Drug interactions, Clinical interpretation, Technique used for estimation and importance of Therapeutic Drug Monitoring of following drugs:- Digoxin, Valproic Acid, Amikacin, Procainamide, Aspirin, Gentamicin, Phenytoin, Carbamazepine, Lidocaine, Phenobarbitone, Rifampicin, Lithium, Quinidine, Imipramine, Theophyllin	3
	Cytotoxic and Hepatotoxic drugs:- Classification of Cytotoxic drugs, Mechanism of action, Pharmacokinetics, Adverse drug reaction, potential drug interactions, Importance and necessity of Therapeutic Drug Monitoring of cytotoxic and various heapatotoxic drugs	3
	Bioequivalance and Therapeutic Eequivalance: Definition and concept, terminology involved, Invivo bioequivalacne criteria and issue, Study design for assessment of the bioavailiability and bioquivalnce, statistical criterias, Regulatory requirements, Type of bioequivalence studies, Pharmacodybamic modles for bioequivalence, Fundametals of integrated PH/PD in models and importance of Bioequivalnce.	4
	Clinical case reports and Discussion	2
	• Pharmacotherapy, Dipiro, Appleton and Lange, Norwalk, Connectiut, Second Edi., 1992 • Drug level Monitoring, John Wiley, Sudee and Beeten, 1980 • Clark's Isolation and identification of drugs, Pharmaceutical press London, 1986. • Clinical Chemistry , Riehterich and column, John Wiley, 1981 • Therapeutic Drug Monitoring and Toxicology by liquid chromatography, Steven Hywong, Vol. 32, Marcel Dekker Inc., 1985 • Therapeutic Drug Monitoring, B. Widdop (Edi), Churchill Livingstone, 3 1985 • Therapeutic Drug Monitoring, and Clinical Biochemistry, Mike Hallworth, Nigel, capps, ACB Venture Publications, 1993 • Simkin Handbook of Therapeutic Drug Monitoring, William J. Taylor, J. Daniel Robinson, Simkin Inc., Gainesville, 1991 • Therapeutic Drug Monintiring Clinical Guide, Second Edi., Abbot Laboratories Diagnostic Division, 1994 • Pharmaceutical Bioquivalance, P. G. Welling, Francies L.S. Tse, Shrikant V.	

23	**PHT 2009– Bulk Drug Technology and Process Chemistry (50 marks) 3hr./week**	
	1. Importance of Development of Bulk Drug Technology 2. Import, Export of Bulk drugs 3. Development of Process chemistry 4. Plant Layout, Plant Design, Utilities, Process Flowsheets, etc 5. Raw Material Consumption and Cost 6. Safety, Pollution Control and Effluent Treatment 7. Good Laboratory and Manufacturing Practices 8. Quality Assurance and Regulatory Affairs	1 1 6 5 2 3 6 6
	• Manufacturing Technology of Drug by Sitting and Sitting • Encyclopedia of Chemical Technology by Kirk-Othmer • Handling of Hazardous Chemicals and Pollution Control	
24	**PHT 2010– Investigational Drug and Clinical Research (50 marks) 3hr./week**	
	Transmembrane movement of drug molecules, drug absorption, distribution, pathways of drug biotransformation and the environmental and genetic factors and drug metabolism studies, Drug-receptor interactions. Evaluation of new chemical entities including natural products and synthetic compounds Current concepts of drug discovery Preclinical development: carcinogenicity, mutagenicity, teratogenicity Drug registration and clinical trials Post marketing surveillance.	
25	**PHT 2011 – Advances in Receptor Pharmacology (50 marks) 3hr./week**	
	Receptor classification Ion Channels: Transmitter gated channels / ligand gated channels. Eg. Nicotinic receptors, GABAa or glutamate receptors G-protein coupled receptor – G-proteins function, β- adrenergic receptors, muscarinic receptors. Cytosolic receptors / Transcriptional regulators e.g. steroid receptors, hormone receptors Second messenger systems	
	• Pharmacology 3rd edition –H. P. Rang and M. M. Dale • Textbook of receptor Pharmacology by John C. Foreman, Torben Johasen • Drug receptors and their effectors edited by Niel J. M. Birdsall • Drug receptors by H. P. Raug	
26	**PHT 2012– Medicinal Natural Products (50 marks) 3hr./week**	
	General biosynthetic pathways in the formation of secondary metabolites	

	Methods of investigation in biogenetic studies. Biosynthesis of phenyl propanoids Isolation, identification, classification, structure determination and important pharmacological activities of flavonoids. Detailed study of rutin including extraction and isolation. Tumour inhibitors from plants. Pesticides of natural origin. Poisonous plants. Plant allergens.	
	• Medicinal Natural Products- A Biosynthetic Approach. Dewick P.M. 2nd edition/2002 John Wiley & Sons Ltd. • Pharmacognosy & Phytochemistry Medicinal Plants. Bruneton J. 2nd edition/1999 Lavoisier Publishing Inc. • Phytochemical Methods- A Guide to modern techniques of Plant analysis. Harborne J.B. 3rd edition/1998 Springer • Natural Products- A Laboratory Guide Ikan R.2nd edition/1994 Academic Press • Pharmacognosy. Tyler V.E. 8th edition/1981 Lea & Febiger • Textbook of Pharmacognosy. Trease & Evans, 15th edition/2002 Harcourt Publishers • Textbook of Pharmacognosy. Wallis 5th edition/1967 J. & A. Churchill Ltd. • Plant Drug Analysis- A Thin Layer Chromatography Atlas Wagner H. 1984 Springer-Verlag • Wealth of India (11 volumes) Publications and Information Directorate, CSIR 1992 • Atlas of Microscopy of Medicinal Plants, Culinary Herbs and Spices Jackson B.P. CBS Publishers • The Merck Index Merck Research Laboratories 13th edition, 2001 Merck & Co., Inc	
27	**PHT 2013 – Advanced Pharmacology (50 marks) 3hr./week**	
	Experimental evaluation of drugs with preliminary principles of clinical evaluation study of models for testing: Analgesics, Antipyretic an Anti- inflammatory Local anaesthetic Tranguillisers and seadatives Diuretic Anticonvulsants Hypoglycemic agents CNS active CVS active Antihistaminics Immunomodulators etc. Use of monoclonal antibodies.	

	Trnasgenic animal models and Knock-out animals.	
	• Drug Discovery and Evaluation by H. Gerhard Vogel • Screening methodology in Pharmacology –II by Turner and Hebborn • Drug discovery The evolution of modern medicines by Walter Sneader • Evaluation of drug activities by Laurence and Bacharach- Vol. I & II • Safety evaluation of drugs and chemicals by W. Eugene Lloyd • Pharmacology 3rd edition –H. P. Rang and M. M. Dale	
28	**PHT 2014 – Chiral Synthesis (50 marks) 3hr./week**	
	Introduction, concept and importance of chirality Resolution of racemic mixtures Stereoselective and stereospecific synthesis Classification of types of reactions involved in chiral sysnthesis for compounds with one and two chiral centers Examples of reactions of the above types; useful in drug synthesis to be covered. Analytical methods in chiral synthesis.	
	• Chirality in Industry Vol –I, II and III , R. A. Sheldon, • Chiral catalysis, Noyori, Asymmetric Catalysis vol I, II & III , Noyori.	
29	**PHT 2015 – Design of Enzyme Inhibitors (50 marks) 3hr./week**	
	Enzyme structure and function Enzyme kinetics Enzyme Inhibitors: Reversible and irreversible. Active sites and docking analysis, enzyme-substrate interaction, X-ray crystal structure and drug design. Protein data bank. Design of HIV – 1 protease inhibitors, Cytochrome P_{450} inhibitors, DHFR inhibitors, Cyclooxygenase inhibitors. Examples of development of NCE as enzyme inhibitor.	
	• Enzyme Inhibition in Drug Discovery and Development Published Online: 23 Feb 2010, Editor(s): Chuang Lu, Albert P. Li, Print ISBN: 9780470281741 Online ISBN: 9780470538951. DOI: 10.1002/9780470538951Copyright © 2010 John Wiley & Sons, Inc. • Enzymes and Their Inhibitors: Drug Development (Enzyme Inhibitors) by H. John Smith, Claire Simons • Burger's Medicinal Chemistry and Drug Discovery. Copyright ©1999-2010 by John Wiley & Sons, Inc. All Rights Reserved. • Textbook of Drug Design and Discovery, Third Edition ~ Editors: Povl Krogsgaard- Larsen, Tommy Liljefors, Ulf Madsen	
30	**PHT 2016– Quality Assurance and Validation (50 marks) 3hr./week**	
	CGMP – Status and regulations, GLP Validation: Process validation for sterile and non-sterile formulations Validation of Pharmaceutical water systems, validation of utilities, validation of environmental control systems, systems validation and quality audits. Documentation	
	• Beotra's Law of Drugs Medicins and Cosmetics K. K. Singh, L. R. Bugga	

	for the Law Book Co. Pvt. Ltd. Allahabad • Modern Pharmaceutics, G. S. Banker, New York, Marcel Dekker 1990 • Fundamentals of Pharmacy, Blome H. E., Philadelphia, Fea and Febiger, 1985 • Pharmaceutical Production Facilities: Design and Applications, G. C. Cole, New York Ellis Horwood 1990 • Microbial Quality Assurance in Pharmaceuticals Cosmetics and Toiletries, S. F. Bloomfield, Chichester, Ellis, Horwood, 1998. • Encyclopedia of Pharmaceutical Technology, J. Swarbrick, New York, Marcel Dekker, 1993 • Remington's Pharmaceutical Sciences, A. R. Gennaro Mac Pub. Co. Easton, Pennsylvania 1990 • Indian Pahrmacopoiea, British Pahrmcopoiea, United States Pharmcopoiea. • Good Laboratory Practice Regulations A. F. Hirsch, New York, Marcel Dekker, 1989 • Good Laboratory Practice Regulations Weinberg New York, Marcel Dekker, 1995.	
31	**PHT 2104– Advanced Instrumental techniques for Material Characterization (50 marks) 3hr./week**	
	Principles, configuration of the instruments, specimen preparation, micro-nanostructure and surface characterization, limitations, pharmaceutical applications of : 1. Scanning microscopy: SEM, SEM & X-ray microanalysis, STEM 2. Scanning probe microscopy: AFM, STM 3. Fluorescence and confocal microscopy 4. Chemical imaging techniques: NIR, MRI 5. Advanced thermal analytical techniques 6. Ultrasound spectroscopy 7. Light scattering spectroscopy based techniques	6 6 3 4 4 2 5
	• Scanning Microscopy for Nanotechnology(Techniques and applications), Weile Zhou, Zhong Lin Wang; Nanocharactisation, Augus I. Kirkland and John L. Hutchison; • Scanning Electron Microscopy and X-ray Microanalysis, J. Goldstein; Scannimg Probe Microscopy The Lab on a Tip, E. Meyer, H.J. Hug and R. Bennewitz.	