INSTITUTE OF CHEMICAL TECHNOLOGY
Ordinances, Regulations and Syllabi relating to the Degree of Master of Pharmacy

1. Introduction

The Institute is revamping its academic structure especially for the masters courses by way of introducing the compulsory industrial training for a period of six months (to be taken in the third semester of the program). The number of credits in the first two semesters has also been increased and a research component has been included. The total credits in the first two semesters now stand at 27 each instead of earlier 21. All the courses will continue to be credit based and the evaluation will be grade based.

The Departmental administrative committee and academic program committee periodically proposed the program outcomes having consistency with the graduate attributes available with NBA. The committee critically analysed information obtained from graduated students, employers and immediately passed out students. The program outcomes are as follows:

SR. NO.	PROGRAM OUTCOMES (POS)
1	The graduates will be able to apply knowledge of basic sciences (Mathematics, Physics, Chemistry and Biology) and technology courses in getting solutions to issues pertaining to chemical and allied industries.
2	The graduates should be able to systematically break up complex problems in realizable steps and solve them.
3	The graduates will be able to design a system or a component of a system or provide a technical solution for a specific task within realistic constraints
4	The graduates will be able to design and conduct experiments as well as analyze and interpret data. The graduates should be able to systematically break up complex problems in realizable steps and solve them.
5	The graduate will be able to use modern tools, software, equipment etc. to analyze and obtain solution to the problems.
6	The graduates will be able to study the impact of process industry on the global, economic, and societal context
7	The graduates should practice their profession considering environmental protection and sustainability
8	Graduates are expected to practice professional skills in an ethical manner
9	The graduates should have competence to undertake designated task on individual or team basis as per the requirement.
10	The graduates will be able to communicate effectively their points of view
11	The graduates will acquire attitude for life- long learning
12	The graduates should actively participate in project and financial management

SR. NO.	PROGRAM SPECIFIC OUTCOMES (PSOs)
13	Graduates will be acquainted with the latest development in different fields so as to enable them to take up higher studies, research & developmental work
14	Graduates will be introduced to managerial subjects, so as to enable them to take up further studies in management subjects & function effectively as managers

Credit system is a systematic way of describing an educational programme by attaching credits to its components. The definition of credits may be based on different parameters, such as student workload, learning outcomes and contact hours. It is a student-centric system based on the **student workload** required to achieve the objectives of a programme. It should facilitate academic recognition of the courses and mobility of the students. Credits assignment is based on the principle that Credits can only be obtained after successful completion of the work required and appropriate assessment of the learning outcomes achieved. As per the AICTE norms 2L/week of lectures are 2 credits, while 2h/week of practical//seminar/literature review/research work are 1 credit. This has been taken as the basis during the working of the proposed syllabus.

Student workload consists of the time required to complete all prescribed learning activities such as attendance at lectures/practical, seminars, projects, etc. Credits are allocated to all the educational components of a study programme and indicate the quantity of work each component requires to achieve its specific objectives.

Evaluation is an important component of any teaching-learning process. The Institute gives emphasis on continuous evaluation with considerable freedom to the teacher in deciding the mode of evaluation of the students. The performance of the student is documented by a **grade** at the end of the semester. The grading scale ranks the students on a statistical basis. Therefore, statistical data on student performance is a prerequisite for applying the grading system.

2. Course Credits

In general a certain quantum of work measured in terms of **credits** is laid down as the requirement for a particular degree. The student acquires credits by passing courses every semester, the amount of credit associated with a course being dependent upon the number of hours of instruction per week in that course.

There are mainly two types of courses in the Institute - lecture courses and laboratory courses. Lecture courses consist of lecture (L) and tutorial (T) hours. Laboratory courses consist of practical (P) hours. The credit (C) for a course is dependent on the number of hours of instruction per week in that course, as given below:

(1) 1h/week of lecture (L) or tutorial (T) = 1 credit
(2) 2h/week of Practicals (P) = 1 credit
(3) Credit (C) for a theory course = No. of hours of lectures per week + No. of hours of tutorials per week = L + T
(4) Credits (C) for a Laboratory course/Seminar/research work = ½ x No. of hours per week

Credits will be assigned to In-plant, Seminar, Projects and other mandatory course requirements also and these will be mentioned in the respective syllabi. There may be some non-credit requirements. A student is required to earn credits as mentioned in the syllabus.

3. Evaluation

3.1 The weightages of different modes of assessments shall be as under.

	In-Semester evaluation		End-Semester-Exam	Components of continuous mode
	Continuous mode	Mid Semester-Exam		
Theory	20%	30%	50%	Quizzes, class tests (open or closed book), home assignments, group assignments, *viva-voce* assignments, discussions
Practical	50%	-	50%	Attendance, *viva -voce*, journal, assignments, project, experiments, tests
Seminar/ Research work			100%	Continuous evaluation not applicable, End semester evaluation will be based on written report evaluation and presentation in front of the external examiner within the Department

3.2. In-Semester Evaluation:

(a) It is expected that the teacher would conduct at least two assessments (in any form as quizzes, tests, home work, group work etc) under the continuous mode in a Semester.
(b) The teacher will announce at the beginning of the respective course the method of conducting the tests under the continuous mode and the assignment of marks
(c) In-semester performance of all students should be displayed and sent to the academic office by the teacher at least 15 days before the end-semester examination.
(d) For the theory courses, there will be one mid-semester test for each course to be held as per the schedule fixed in the Academic Calendar.
(e) For mid –semester examinations in theory papers, duration of examination will be 1 hour for 3 credit courses and 2 hours for 4 credit courses

3.3. End-Semester examination:

a) The semester end examination will cover the full syllabus of the course and will be conducted as per the Institutional time table at the end of each semester.
b) For end –semester examinations in theory papers, duration of examination will be 1 hour for 3 credit courses and 2 hours for 4 credit courses
c) For the end semester evaluation of seminar/research work, student will be expected to submit a written report and also make a presentation. The evaluation will be based on the quality of the written report and presentation.

3.4 Passes and Fail

(a)The candidates whoobtain 40% and more marks of the total marks of a course head shall be deemed to have **passed** the respective course head.
(b) The candidates whoobtain marks less than 40% of the total marks of a course head shall be deemed to have **failed** in the respective course head **(Grade FF).**

3.5Grades:

(a) The performance of a student shall be documented by a **Letter grade.** Each letter grade has a **Grade point** associated with it. The Grades and Grade points shall be assigned to each head of passing and both will be indicated in the mark-list of the semester examination.

(c) The total marks (in-semester + end-semester) of a candidate in a subject head are converted into a letter grade, based on the relative (and some times the absolute) performance of the student.

Letter Grade	**Grade Point**
AA	10
AB	9
BB	8
BC	7
CC	6.5
CD	6
DD	5.5
EE	5

(d) For granting class, a grade point of 6.0 and above will be considered equivalent to First class.
(c) The grades to be allotted in the case of students who fail or do not appear at the end-semester examination shall be as under.

Letter Grade	**Grade Point**	**Explanation**
FF	0	The candidate fails in course head. The candidate will be allowed to take end-semester repeat or subsequent examinations as per rule.
XX		The candidate has not kept term for the course head due to attendance less than requisite. Further see 3.5(g) below. In the above cases, the candidate has to repeat the respective course by paying the fees.
I	0	The candidate has kept term for the course head, has taken all the internal examinations with satisfactory performance, but has failed to take the end-semester examination or repeat examination due to genuine reasons. The candidate will be allowed to take end-semester repeat or subsequent examinations as per rule.
FR	0	The candidate has exhausted all the permissible chances to clear the end-semester examinations. The candidate has to register for the respective semester again for all the subject heads or will be out of the respective degree course as per the rules.
DR	0	(i) The candidate hasn't participated in academic programme. (ii) The candidate has taken a drop for the subject head;

		- provided he/she intimates the same (i or ii) at least 7 days in advance of the commencement of the end-semester examination for the respective year.

(d) Grades **FF** and **I** are place-holders only and do not enter into CPI/SPI calculations directly. These grades get converted to one of the regular grades after the end-semester examination.

(e) A candidate with an **FR** grade is not eligible for any repeat examination in that course and has to re-register for that semester by paying the appropriate fees.

(f) **I** grade will not be continued beyond the permissible number of end-semester/repeat examinations.

(g) **'XX' Grade:** The grade **XX** in a course is awarded if – (i) candidate does not maintain the minimum 75% attendance in the Lecture/Tutorial/Practical classes, (ii) candidate receives less than 20% of the combined marks assigned for continuous assessment and mid-semester examination, and (iii) candidate indulges in a misconduct/uses unfair means in the examination, assignments, etc., of a nature serious enough to invite disciplinary action in the opinion of the teacher.
(**Note:** Award of the **XX** grade in the case of g(iii) above shall be done by Disciplinary Action Committee (DAC)).

(h) The names/roll numbers of students to be awarded the **XX** grade should be communicated by the teacher to the Academic office as per academic calendar before the last date of submission of the application for end-semester examination.

3.6. Awarding the grades

The grading scale ranks the students on a statistical basis on the basis of the overall performance of the students of a given class in the given course head. Therefore, statistical data on students' performance is a prerequisite for applying the grading system. While assigning grades in a given course head, it is essential to know the **average marks(AM)** obtained by the students *who have passedthe subject head* and the **highest marks(HM)** obtained in the *same subject head*.

3.6.1. If the **average marks(AM)** obtained by the students *who have passedthe subject head* is <60%, the interval AM shall be awarded grade CC and the other grades shall be decided as follows:
(i) AA, AB, BB, and BC grades shall be decided between the AM and HM by dividing the range in equal intervals.
(ii) CD, DD and EE grades shall be decided between the AM and minimum marks required for passing the head (i.e. 40%) by dividing the range in equal intervals.

3.6.2. If the **average marks(AM)** obtained by the students *who have passedthe subject head* is such that **60% ≤ AM < 70%,** the interval AM shall be awarded grade BC and the other grades shall be decided as follows:

(i) AA, AB, BB grades shall be decided between the AM and HM by dividing the range in equal intervals.
(ii) CC, CD, DD and EE grades shall be decided between the AM and minimum marks required for passing the head (i.e. 40%) by dividing the range in equal intervals.

3.6.3. If the **average marks(AM)** obtained by the students *who have passedthe subject head* is **≥ 70%,** the interval AM shall be awarded grade BB and the other grades shall be decided as follows:
(i) AA and AB grades shall be decided between the AM and HM by dividing the range in equal intervals.
(ii) BC CC, CD, DD and EE grades shall be decided between the AM and minimum marks required for passing the head (i.e. 40%) by dividing the range in equal intervals.

4. SPI and CPI

(a) **Semester Performance Index (SPI):** The performance of a student in a semester is indicated by **Semester Performance Index (SPI),** which is a weighted average of the grade points obtained in all the courses taken by the student in the semester and scaled to a maximum of 10. (SPI is to be calculated upto two decimal places.)
A Semester Grade Point Average (SGPA)will be computed for each semester as follows:

$$SGPA = \frac{\left(\sum_{i=1}^{n} c_i g_i\right)}{\left(\sum_{i=1}^{n} c_i\right)}$$

Where
'n' is the number of courses for the semester,
'c_i' is the number of credits allotted to a particular course, and
'g_i' is the grade-points awarded to the student for the course based on his performance as per the above table.
SGPA will be rounded off to the second place of decimal and recorded as such.

(b) **Cumulative Performance Index (CPI):** An up to date assessment of the overall performance of a student from the time he entered the Institute is obtained by calculating **Cumulative Performance Index (CPI)** of a student. The CPI is weighted average of the grade points obtained in all the courses registered by the student since he entered the Institute. CPI is also calculated at the end of every semester (upto two decimal places).

Starting from the first semester at the end of each semester (S), a Cumulative Grade Point Average (CGPA) will be computed as follows:

$$CGPA = \frac{\left(\sum_{i=1}^{m} c_i g_i\right)}{\left(\sum_{i=1}^{m} c_i\right)}$$

Where
'm' is the total number of courses from the first semester onwards up to and including the semester S,
'c_i' is the number of credits allotted to a particular course, and
'g_i' is the grade-points awarded to the student for the course based on his performance as per the above table.
CGPA will be rounded off to the second place of decimal and recorded as such.

(c) The CGPA, SGPA and the grades obtained in all the subjects in a semester will be communicated to every student at the end of every semester / beginning of the next semester.

(d) **When** a student gets the grade 'FF', or I' in any subject head during a semester, the SGPA and CGPA from that semester onwards will be tentatively calculated, taking only 'zero' grade point for each such 'FF' or 'I' grade. When the 'FF' grade(s) has / have been substituted by better grades after the repeat examination or subsequent semester examination, the SGPA and CGPA will be recomputed and recorded.

5. Repeat End-Semester Examination

5.1. For those candidates who fail in a subject head or are eligible for appearing at the repeat examination, **Repeat End-Semester Examination** will be conducted within one month from the declaration of the results of regular end-semester examination, as per **Regulation R.14**.

5.2. The marks obtained by candidates in the in-semester examinations (continuous assessment and Mid-Semester Examination) will be carried forward in such cases.

5.3. Grading the performance in the Repeat Examination: The grades will be assigned as per 3.5 and 3.6 above. However, for a candidate taking any repeat examination or subsequent regular semester examination or performance improvement examination shall be awarded **one grade lower** than that decided on the basis of the actual marks obtained; provided 'EE' grade obtained in such an examination shall remain 'EE'. For reference see the table below.

Grade obtained in repeat or subsequent end-semester examination	Grade to be assigned	Grade point
AA	AB	9.0
AB	BB	8.0
BB	BC	7.0
BC	CC	6.5
CC	CD	6.0
CD	DD	5.5
DD	EE	5.0
EE	EE	5.0

5.4. Revaluation of end-semester and repeat examination: Candidate's performance in these examinations will be displayed on proper notice board and after 3 days of such display the marks will be sent to the Academic Office. No revaluation of these examinations will be allowed.

6. Passing of a Semester examination

A candidate shall be declared as **'PASSED'** any semester examination if he/she has
(a) Cleared all heads of passing by securing grades EE or higher in all the heads;
(b) Passed all the heads of passing such as project, seminar, training, etc as per the rules;
(c) Satisfactorily completed all the mandatory requirements of the course;
(d) paid all the Institute dues;
(e) No case of indiscipline pending against him/her.

7. Eligibility for the Award of a Degree

A candidate shall be declared eligible for the award of a degree, if he/she has cleared all the semester examinations as given in (6) above.

8. Allowed to keep terms (ATKT)

8.1 A candidate who has I grade in one or more heads of passing of an odd semester of an academic year shall be allowed to keep terms for the respective even semester.

8.2. A candidate shall be allowed to keep terms for the subsequent academic year if he/she has FF or I grades in not more than two heads of passing from all the heads of passing of the two terms of the previous academic year taken together. Such a candidate shall be declared as **FAILED, ATKT**.

9. Repeating a course

9.1 A student is required to repeat the course under the following situations:
(a) A student who gets an **XX, FR, or DR** grade in a course; or
(b) A student has exhausted all permissible chances to clear the course.

9.2 A candidate from first year who remains absent for the regular end-semester examination of a semester and the corresponding repeat examination for **ALL SUBJECTS** shall have to take fresh admission for the corresponding year; unless the candidate has dropped out / terminated from the course.

9.3 If a candidate at the Second, fails to pass any semester examination in not more than 4 consecutive examinations, including the repeat examinations, from the date of registering for the respective year, the candidate shall have to take readmission for the corresponding year again in which the failure has occurred, provided the course is not changed.

10. Improvement of performance

A candidate will be allowed to appear at the **entire examination** after the regular end-semester examination as per the respective rules to improve the performance. In such a case if the result of the examination repeated –

1. Is better than the previous one, the previous result shall be declared null and void; and
2. Is worse than the previous one, the result of the subsequent examination shall not be declared.
3. However, awarding of final grade will be made under the provision of sub clause 5.3 above.

11. Exit rules for poorly performing students

A candidate shall be excluded from a course under the following conditions:

(a) If he/she fails to pass any semester examination of the any year of the course in not more than four consecutive attempts (Examination conducted by Institute) from the date of joining the course.
(b) If he/she does not keep two consecutive terms without giving any reasonable justification (as prescribed by the institute) for doing so.
(c) If a candidate fails tofulfill all the requirements of his/her respective degree within the prescribed period from the date of taking admission to the course, the candidate shall be excluded from the course.

12. Miscellaneous

(a) Although CPI will be given in the Semester grade report, the final degree certificate will not mention any **Class** whatsoever.
(b) Not withstanding anything said above if a course is revised /restructured then transient provisions applicable at the time of revision /restructuring shall be applicable.

SYLLABUS STRUCTURE - M. PHARM

BRANCH- Pharmaceutics

No.	Subject	Credit	Hr/Week			Marks			
			L	T	P	Continuous Assessment	Mid-semester Examination	Final Examination	Total
SEMESTER I									
PHT 2101	Core I: Research Methodology	3	2	1	0	10	15	25	50
PHT 2102	Core II: Drug Delivery Systems- I	3	2	1	0	10	15	25	50
PHT 2103	Core III: Advanced Pharmaceutics	3	2	1	0	10	15	25	50
	Elective I	3	2	1	0	10	15	25	50
	Elective II	3	2	1	0	10	15	25	50
PHP 2505	Instrumental Methods of Analysis Laboratory	3			6	25		25	50
PHP 2521	Seminar and Critical Review of one research publication	3	---	---	6			30 (Report) 20 (Presentation)	50
PHP 2522	Research Project I	6	---	---	12			60 (Report) 40 (Presentation)	100
	TOTAL:	27	10	5	24				450
SEMESTER II									
PHT 2106	Core IV: Models for Drug Delivery Systems Evaluation	3	2	1	0	10	15	25	50
PHT 2105	Core V: Drug Delivery Systems – II	3	2	1	0	10	15	25	50
PHT 2107	Core VI: Targeted Drug Delivery Systems	3	2	1	0	10	15	25	50
	Elective III	3	2	1	0	10	15	25	50
	Elective IV	3	2	1	0	10	15	25	50
PHP 2506	Advanced Pharmaceutics Laboratory	3			6	25		25	50
PHP 2523	Research Project II	9	---	---	18			90 (Report) 60 (Presentation)	150
	TOTAL:	27	10	5	24				450
SEMESTERS III									
PHP 2524- Industrial Training of duration of minimum of 15 weeks to maximum of 6 months as per approval of research supervisor and Head of the Department with total assigned credit as 30 and marks as 450									
SEMESTER IV									
PHP 2525- Research Project, Thesis and Open defense with total assigned credit as 30 and marks as 450									

BRANCH- Pharmaceutical Chemistry

No.	Subject	Credit	Hr/Week			Marks			
			L	T	P	Continuous Assessment	Mid-semester Examination	Final Examination	Total
SEMESTER I									
PHT 2101	Core I: Research Methodology	3	2	1	0	10	15	25	50
PHT 2201	Core II: Advanced Organic Chemistry-I	3	2	1	0	10	15	25	50
PHT 2202	Core III: Advanced Medicinal Chemistry-I	3	2	1	0	10	15	25	50
	Elective I	3	2	1	0	10	15	25	50
	Elective II	3	2	1	0	10	15	25	50
PHP 2505	Instrumental Methods of Analysis Laboratory	3			6	25		25	50
PHP 2521	Seminar and Critical Review of one research publication	3	---	---	6			30 (Report) 20 (Presentation)	50
PHP 2522	Research Project I	6	---	---	12			60 (Report) 40 (Presentation)	100
	TOTAL:	27	10	5	24				450
SEMESTER II									
PHT 2204	Core IVSpectroscopy	3	2	1	0	10	15	25	50
PHT 2206	Core V: Advanced Pharmaceutical Chemistry	3	2	1	0	10	15	25	50
PHT 2205	Core VI: Advanced Medicinal Chemistry-II	3	2	1	0	10	15	25	50
	Elective III	3	2	1	0	10	15	25	50
	Elective IV	3	2	1	0	10	15	25	50
PHP 2507	Advanced Pharmaceutical and Medicinal Chemistry Laboratory	3			6	25		25	50
PHP 2523	Research Project II	9	---	---	18			90 (Report) 60 (Presentation)	150
	TOTAL:	27	10	5	24				450
SEMESTERS III									
PHP 2524- Industrial Training of duration of minimum of 15 weeks to maximum of 6 months as per approval of research supervisor and Head of the Department with total assigned credit as 30 and marks as 450									
SEMESTER IV									
PHP 2525- Research Project, Thesis and Open defense with total assigned credit as 30 and marks as 450									

BRANCH- Medicinal and Natural Products

No.	Subject	Credit	Hr/Week			Marks			
			L	T	P	Continuous Assessment	Mid-semester Examination	Final Examination	Total
SEMESTER I									
PHT 2101	Core I: Research Methodology	3	2	1	0	10	15	25	50
PHT 2301	Core II: Pharmacognosy and Phytochemistry	3	2	1	0	10	15	25	50
PHT 2302	Core III: Pharmacology, Toxicology and Therapeutics	3	2	1	0	10	15	25	50
	Elective I	3	2	1	0	10	15	25	50
	Elective II	3	2	1	0	10	15	25	50
PHP 2505	Instrumental Methods of Analysis Laboratory	3			6	25		25	50
PHP 2521	Seminar and Critical Review of one research publication	3	---	---	6			30 (Report) 20 (Presentation)	50
PHP 2522	Research Project I	6	---	---	12			60 (Report) 40 (Presentation)	100
	TOTAL:	27	10	5	24				450
SEMESTER II									
PHT 2106	Core IV: Models for Drug Delivery Systems Evaluation	3	2	1	0	10	15	25	50
PHT 2303	Core V: Topics in Pharmacology	3	2	1	0	10	15	25	50
PHT 2304	Core VI: Advanced Pharmacognosy and Phytochemistry	3	2	1	0	10	15	25	50
	Elective III	3	2	1	0	10	15	25	50
	Elective IV	3	2	1	0	10	15	25	50
PHP 2508	Advanced Medicinal Natural Products Laboratory	3			6	25		25	50
PHP 2523	Research Project II	9	---	---	18			90 (Report) 60 (Presentation)	150
	TOTAL:	27	10	5	24				450
SEMESTERS III									
PHP 2524- Industrial Training of duration of minimum of 15 weeks to maximum of 6 months as per approval of research supervisor and Head of the Department with total assigned credit as 30 and marks as 450									
SEMESTER IV									
PHP 2525- Research Project, Thesis and Open defensewith total assigned credit as 30 and marks as 450									

List of Electives

1. PHT 2001-Biopharmaceuticcs and Pharmacokinetics
2. PHT 2002-Intellectual property Rights and Patent Filing
3. PHT 2003-Advanced Biochemistry
4. PHT 2004-Drug Metabolism
5. PHT 2005-Molecular Biology
6. PHT 2007-Packaging Technology
7. PHT 2012-Medicinal Natural Products
8. PHT 2014-Chiral Synthesis
9. PHT 2016-Quality Assurance and Validation
10. PHT 2023- Technological of Fine and Speciality Chemicals
11. PHT 2305 - Clinical Research Management
12. PHT 2011- Advances in Receptor Pharmacology
13. PYT 2106- Physical Methods of Analysis
14. PHT 2022 – Active Pharmaceutical Ingredients Technology

Note: Cores of other branches of M. Pharm and other M.Tech courses can be taken as electives.

NEW / MODIFIED COURSES
BRANCH: PHARMACEUTICS

SEMESTER I

	Course Code: PHT 2101	Course Title: Research Methodology	Credits = 3		
			L	T	P
	Semester: I	Total contact hours: 45	2	1	0
List of Prerequisite Courses					
List of Courses where this course will be prerequisite					
Description of relevance of this course in the M. Pharm / M. Tech. Program					

Sr. No.	Course Contents (Topics and subtopics)	Reqd. hours
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	
14	Presentation (Specially for oral) • 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	
15	Protection of patents and trade marks, Designs and copyrights • 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	
16	Sources for procurement of Research Grants	
17	Industrial- Institution Interaction - Industrial projects – Their feasibility reports	
List of Text Books/ Reference Books		
1	Research in Education – Johan V. Best James V. Kahn	
2	Presentation skills- Michael Halton- Indian Society for Institute Education	
3	A Practical Introduction to copy right – Gavin Mcfarlane	
4	Thesis projects in Science and Engineering – Richard M. Davis	
5	Scientists in legal system – Ann labor science	
6	Thesis and Assignment writing – Jonathan Anderson	
7	Writing a technical paper- Donald Menzel	
8	Effective Business Report writing – Leland Brown	
9	Protection of Industrial property rights- Purushottam Das and Gokul Das	
10	Spelling for the million – Edna furmess	
11	Preparing for publication – King Edwards Hospital fund for London	
12	Information technology – The Hindu speaks	
13	Documentation – Genesis & Development 3792	
14	Manual for evaluation of Industrial projects – United Nations	
15	Manual for the preparation of Industrial feasibility studies	
Course Outcomes (students will be able to…..)		
1		
2		

	Course Code: PHT 2102	Course Title: Drug Delivery Systems – I	Credits = 3		
			L	T	P
	Semester: I	Total contact hours: 45	2	1	0
List of Prerequisite Courses					
	B. Pharm courses (Pharmaceutics) of ICT or equivalence				
List of Courses where this course will be prerequisite					
Description of relevance of this course in the M. Pharm Program					
To train the students on science and technology aspects of drug delivery systems					

Sr. No.	Course Contents (Topics and subtopics)	Reqd. hours	
		L (30)	T (15)
1	Design, development, manufacture and evaluation of the following:		
2	Oral Drug Delivery Systems: Osmotic DDS, Ionexchange controlled DDS, Hydrodynamically balanced DDS including recent advances	8	4
3	Mucosal DDS: Physiological basis of mucosal delivery with reference to oral mucosal, nasal, vaginal and rectal routes. Bioadhesion and bioadhesive polymers, DDS for mucosal administration.	7	4
4	Transdermal DDS: Percutaneous absorption and penetration enhancers, development of transdermal gels, patches with reference to manufacturing equipment components and evaluation. Iontophoretic and Sonophoretic DDS.	7	3
5	Ocular DDS –Design of CR ophthalmic DDS including gels, inserts, novel DDS and evaluation.	4	2
6	Dental DDS: DDS for oral conditions, and dental care and therapy including periodontal disease, dental caries etc.	2	1
7	Veterinary DDS – Physiological basis, devices and formulation	2	1

List of Text Books/ Reference Books

1	Handbook of Pharmaceutical Controlled Release Technology, edited by Donald Wise Marcel Dekker, 2000.
2	Oral Mucosal Drug Delivery by Michael J. Rathbone (Editor) Marcel Dekker; (June 1996)
3	Bioadhesive Drug Delivery Systems Fundamentals, Novel Approaches, and Development Series Volume: 98 Edited By: Edith Mathiowitz; Don E. Chickering; Claus-Michael Lehr 1999.
4	Nasal Systematic Drug Delvery Series Volume: 39 Yie W. Chien; Kenneth S. E. Su; Shyi-Feu Chang 1989.
5	Transdermal Drug Delivery by Richard H. Guy (Editor), Jonathan Hadgraft (Editor), Michiko Elizabeth BarroYusa Marcel Dekker; 2nd edition (January 2003)
6	Electricity Assisted Transdermal and Topical Drug Delivery by Ajay K. Banga, Tayior and Francis; (September 1998)
7	Mechanisms of Transdermal Drug Delivery Volume: 83 Edited By: Russell O. Potts; Richard H. Guy. 1997.
8	Transdermal Controlled Systemic medications by Y. W. Chien, Marcel Dekker, 1987
9	Biopharmaceutics of Ocular Drug Delivery by Peter Edman CRC Press: (November 18, 1992)
10	Ophthalmic Drug Delivery Systems, edited by AshimMitra, Marcel Dekker, 1993.
11	Novel Drug Delivery Systems Second Edition, Revised and Expanded Series Volume: 50 Yie W. Chien, 1991
12	Controlled Release Veterinary Drug Delivery by Michael J. Rathbone (Editor), Robert Gurny (Editor)Elservier Science; 1st edition (July 1, 200)
13	Polymeric Drugs and drug Delivery Systems Raphael M. Ottenbrite and Sung Wan Kim, eds. Technomic, 2001.
14	Controlled Drug Delivery – Foudamentals& applications by J. R. Robinson-2nd edition – Marcel Dekker, 1987

15	Polymeric Drugs and drug Delivery Systems Raphael M. Ottenbrite and Sung Wan Kim, eds. Technomic, 2001.	
16	Controlled Drug Delivery – Foudamentals& applications by J. R. Robinson-2nd edition – Marcel Dekker, 1987	
17	Dermatological Formulations: Percutaneous absorption by Brian W. Barry.	
Course Outcomes (students will be able to…..)		
1	Understand design and development of oral drug delivery system	
2	Understand design and development of mucosal drug delivery system	
3	Understand design and development of transdermal drug delivery system	
4	Understand design and development of ocular drug delivery system	
5	Understand design and development of dental drug delivery system	
6	Understand design and development of Veterinary drug delivery system	

	Course Code: PHT 2103	**Course Title: Advanced Pharmaceutics**	**Credits = 3**		
			L	**T**	**P**
	Semester: I	**Total contact hours: 45**	**2**	**1**	**0**
List of Prerequisite Courses					
	B. Pharm courses (Pharmaceutics) of ICT or equivalence				
List of Courses where this course will be prerequisite					

Description of relevance of this course in the M. Pharm Program

To train the students on advanced pharmaceutical aspects and regulations involved in pharmaceutical industry

Sr. No.	**Course Contents (Topics and subtopics)**	**Reqd. hours**	
		L (30)	**T (15)**
1	Polymers: Introduction to methods of polymerization of homo and hetero polymers. Mol.weight of polymers, flow characteristics of polymers. Crystallinity and phase transitions, polymers degradation & stabilization, polymer properties and their evaluation, Polymers for controlled release Bioadhesive polymers, stimuli sensitive polymers. Biodegradable polymers, Biodegradation of polymers, enzymatically degradable bonds in synthetic polymers.	6	2
2	Pharmaceutical Preformulation design and methodology	2	1
3	ICH guidelines	4	2
4	Pelletization and design and evaluation of multiparticulate oral systems	3	2
5	Physics of Compression & Compaction	2	1
6	Validation Process and Equipment in formulation development	6	3
7	Dissolution testing, medium selection and validation of dissolution apparatus	5	3
8	Statistical Designs including Factorial and other approaches. Introduction to Artificial Neural Networks	2	1

List of Text Books/ Reference Books		
1	Handbook of Polymers for Pharmaceutical Technologies, Volume 1 and volume 3 – Wiley publisher	
2	http://www.ich.org/products/guidelines.html	
3	Multi particulate Oral Drug Delivery, Marcel Dekker; 1st edition (June 15, 1994)	
4	Compression and consolidation, the theory and practice of industrial pharmacy, Lachman,	

	L.liberman, H.A. and kanig, J.L.;2009; Page No-66-99,	
5	Textbook of physical pharmaceutics, CVS Subramanyam; Page No 224-227	
6	V. Patravale, M. Rustomjee, J. Disouza. Pharmaceutical Product Development: Insights into Pharmaceutical Processes, Management and Regulatory Affairs. CRC press 2016	
7	Pharmaceutical process validation, 3rd edition, volume 129, Marcel and DeKker series 2003	
Course Outcomes (students will be able to…..)		
1	Understand basics of polymers, different types of polymers and its use in drug delivery system	
2	Understand preformulation design and technology	
3	Understand ICH guidelines on stability	
4	Understand multiparticulate drug delivery system	
5	Understand validation of process, equipment's, dissolution apparatus	
6	Understand statistical design	

	Course Code: PHP 2505	**Course Title: Instrumental Methods of Analysis Laboratory**	**Credits = 3**		
			L	**T**	**P**
	Semester: I	**Total contact hours: 90**	**0**	**0**	**6**
List of Prerequisite Courses					
	Pharmaceutical Analysis theory and Lab at Undergraduate level				
	Pharmaceutical Formulation theory at Undergraduate level				
List of Courses where this course will be prerequisite					
	Pharmaceutics, Pharmacology, Pharmaceutical Chemistry and Pharmacognosy Lab in following Sem.-II and the research work				
Description of relevance of this course in the M. Tech. Program					
Analysis by instrumental methods is important for all industrial synthesis as well as formulations. Monitoring of processes, raw materials and finished products require instrumental analytical techniques.					

Sr. No.	**Course Contents (Topics and subtopics)**	**Reqd. hours**
1.	UV/Visible Spectroscopy i. Calibration of UV spectrophotometer ii. Study effect of solvent on wavelength maxima of drugs. iii. Find Beer's law limit of drugs in a suitable solvent. iv. Standard calibration curve by UV spectroscopy at a) λ max b) λ max + 10 nm c) λ max – 10 nm v. Determination of pKa by U.V. spectroscopy. vi. Multicomponent analysis by UV-Spectrophotometry vii. Absorbance corrected for interference method viii. Simultaneous equation method ix. Absorbance ratio method x. Area under curve method xi. First derivative spectrophotometric method	24
2.	Analysis of drugs from formulations focusing on separation of drug from the formulation excipients	12
3.	IR Spectroscopy i. Calibration of IR spectrophotometer ii. Sample preparation for I.R. spectroscopy (solid/liquids) and interpretation of IR bands for important functional groups.	12
4.	DSC analysis of drugs in crystalline and amorphous forms.	12

5.	Chromatography: i. HPLC calibration of HPLC column and determination of response factor by HPLC ii. GC Instrumental handling and few analyses of the API intermediates iii. TLC mobile phase selection of a various combination of compounds and reaction monitoring. iv. Preparative TLC analysis. v. pH stability evaluation of a drug by TLC. vi. Separation of components by column chromatography.	18
6.	Structural Interpretation by Spectroscopy: i. Basic interpretations of simple Mass spectra and NMR. ii. Structural elucidation workshop: Interpretation of ^{1}H NMR, ^{13}C NMR, IR and Mass spectrometry of simple compounds (maximum 12 carbon atoms).	12
List of Text Books/ Reference Books		
1.	M. Orchin and H.H. Jaffe - Theory and applications of Ultraviolet spectroscopy. (John Wiley and Sons. N.Y).	
2.	Silverstein, Basseler, Morril- Spectrometric identification of organic compounds (John Wiley and Sons. N.Y).	
3.	Willard, Merritt, Dean - Instrumental methods of analysis (CBS Publishers and Distributors, Delhi).	
4.	J.R. Dyer - Application of absorption Spectroscopy of Organic Compounds (Prentice Hall, London).	
5.	C.N.R. Rao - Chemical Applications of Infrared spectroscopy. (Academic Press, N.Y.).	
6.	L.M. Jackmann and B.D. Sternhell - Application of NMR spectroscopy in organic chemistry (Pergamon Press, London.).	
7.	F.W. McLafferty and F. Turecek- Interpretation of Mass Spectra.	
8.	R.J. Hamilton and P. A. Sewell- Introduction to High Performance Liquid Chromatography. (Chapman and Hall, London).	
9.	J.W. Munson- Pharmaceutical Analysis: Modern methods -Part A and Part B (Marcel Dekker, Inc., New York)	
10.	Introduction to Spectroscopy, 3rd edition, Pavia, Lampman, Kriz, Thomson Publisher.	
11.	Analytical chemistry: A Modern Approach to Analytical Science, 2nd edition by Kellner, Mermet, Otto, Valcarcel Wiley ECH.	
12.	Ewing's Analytical Instrumentation Handbook, 3rd edition, edited by Jack, Cazes, Marcel Dekker.	
13.	P.D. Sethi - Quantitative Analysis of Drugs in Pharmaceutical Formulations (VBS Publishers, Delhi).	
14.	Pharmacopoeia of India (latest edition).	
15.	United State Pharmacopoeia (latest edition).	
16.	British Pharmacopoeia (latest edition).	
17.	A.H. Beckett, J.B. Stenlake - Practical Pharmaceutical Chemistry, Part I and Part II (CBS Publishers Delhi)	
18.	F. D. Snell and C. T. Snell- Colorimetric Methods of analysis (Van Nostrand Reinhold Company, N.Y.).	
19.	Journals: Journal of planar chromatography; Actachromatographica. J. Analytical Chemistry.	
Course Outcomes (students will be able to…..)		
1.	Analyze bulk drugs and formulations.	
2.	Perform calibration of analytical instruments.	
3.	Develop chromatographic mobile phases	
4.	Separate the components of the mixtures and either quantify or isolate preparatively	
5.	Interpret the outcomes of the analytical techniques logically to deduce the structure of the compound and/or conclude about the quality/ purity.	

Semester II

	Course Code: PHT 2106	Course Title: Models for Drug Delivery Systems Evaluation	Credits = 3		
			L	T	P
	Semester: II	Total contact hours: 45	2	1	0
List of Prerequisite Courses					
	Anatomy, Physiology and Pathology-I, II and Pharmacology I, II, III, IV of ICT B Pharm syllabus or any equivalent course.				
List of Courses where this course will be prerequisite					
	Pharmaceutical Technology and drug discovery				
Description of relevance of this course in the M. Pharm / M. Tech. Program					

Sr. No.	Course Contents (Topics and subtopics)	Reqd. hours	
		L(30)	T(15)
1	Pharmacodynamic models for evaluation of DDS containing drugs of various categories eg. Cardiovascular agents; Antidiabetic; Antiinflammatory; Antiepileptic; Anticancer; Hepatoprotectives; Analgesics; Antistress; Antiasthmatic and Antitussives etc.	7	3
2	In vitro cell culture techniques for evaluation of drug permeation from DDS including isolation maintenance of cell lines, culturing monolayers, evaluation of drug transport.	7	3
3	*In vitro*/ ex vivo models for evaluation of Drug absorption	3	2
4	*In vitro* cytotoxicity evaluation using cell cultures and techniques such as MTT assay, Dye uptake etc.	6	4
5	Toxicity testing: In-vitro: *In -vitro* toxicity testing and its application to safety evaluation, General perspectives, *in vitro* toxicity trends and issue, Ocular and cutaneous irritation, Validation of In vitro toxicity tests. Acute, sub acute and chronic toxicity testing – Biochemical basis of toxicity, Design of toxicological studies, Quality assurance in toxicology studies, Toxicity by routes – Parental, oral, percutaneous and inhalation, Target organ toxicity exemplified by hepatotoxicity and cutaneous (dermal) toxicity. Regulatory status- Ethical, moral and professional issues.	7	3

List of Text Books/ Reference Books		
1	Bioassay Techniques for drug Development, Atta Ur Rahman, M. Iqbal Choudhary, William J. Thomsen	
2	In vitro Methods in Pharmacuetical Research, Edited by J. V. Casterll, M. J. Gomer, Lechon, Academic Press.	
3	*In Vitro* Toxicity Testing by John M. Fraizer	
4	General and Applied Toxicology by Bryan Ballantyne, T. Marrs& P. Turner	
Course Outcomes (students will be able to…..)		
1	Design an animal model to evaluate a particular drugs/ excipientsefficacy.	
2	Understand cell lines and use cell culture techniques.	
3	Carry out various cell assays to evaluate a drug for its activity.	
4	Design a toxicological study.	

	Course Code: PHT 2105	Course Title: Drug Delivery System – II	Credits = 3		
			L	T	P
	Semester: II	Total contact hours: 45	2	1	0
List of Prerequisite Courses					
	B. Pharm courses (Pharmaceutics) and M. Pharm courses (Drug delivery system-I) of ICT or equivalent				

List of Courses where this course will be prerequisite			
Description of relevance of this course in the M. Pharm / M. Tech. Program			
To train the students on science and technology of advanced drug delivery systems			
Sr. No.	**Course Contents (Topics and subtopics)**	**Reqd. hours**	
		L (30)	**T (15)**
1	Design, development, manufacture and evaluation of the following:		
2	Parenteral DDS: CR Injectables, implants etc. development and evaluation	5	2
3	Colloidal DDS: Specialized DDS like micro / nano emulsions, SMEDDS, Multiple emulsions, sub micron emulsions, liposomes, niosomes, and other vesicular DDS, nanoparticles, their design and development into final dosage forms, issues and consideration	8	4
4	Peptide and protein based DDS: Chemistry and special features of peptide and protein molecules, stability, analysis, Formulation and evaluation Barriers to peptide and protein delivery; Routes of delivery, Toxicity, immunogenicity, vaccines and gene based DDS.	5	3
5	Pulmonary DDS – Physiological basis and formulation considerations. Design of Pressurized aerosols, Dry powder DDS, Devices for administration and evaluation.	4	2
6	Targeted DDS: Concept of drug targeting, basis for drug targeting both active and passive. Monoclonal antibodies another markers, design of targeted DDS.	4	2
7	Intrauterine Devices, Intravaginal drug delivery system	2	1
8	Miscellaneous DDS: DDS for orthopedic applications Intra coronary stents. (medicated and non-medicated)	2	1
List of Text Books/ Reference Books			
1	Sterile Dosage Forms: Their Preparation and Clinical Application by Salvatore J., M. S. Turco, Salvatore Turco Lea &Febiger; 4th edition (January 1994)		
2	Parentral Quality Control Sterility, Pyrogen, Particulate, and Package Intergrity Testing: Third Edition, Revised and Expanded Series Volume: 125 Michael J. Akers; Dan Larrimore; Dana Morton Guazzo 2002.		
3	Colloidal Drug Delivery Systems by JorgKreuter (Editor) Marcel Dekker; 1st edition (July 15, 1994)		
4	Controlled Release Gel Formulations for Mucosal Drug Delivery edited by MattiasPaulsson Uppsala Univesitet; (December 2001)		
5	Colloidal carriers for controlled drug delivery and targeting: modification, characterization, and in vivo distribution by Rainer H. Muller. WissenschaftlicheVerlagsgesellschaft CRC Press; (1991).		
6	Submicron Emulsions in Drug Targeting and Delivery (Drug Targeting and Delivery) by Simon Benita (Editor) Taylor & Francis; (October 1, 1999)		
7	Multi particulate Oral Drug Delivery. (Editor), Marcel Dekker; 1st edition (June 15, 1994)		
8	Trends and Future Perspectives in Peptide and Protein Drug Delivery (Drug Targeting and Delivery) by Mitsuru Hashida, Yutaka Mizushima (Editor), V. Lee (Editor). Taylor & Francis; (February 1, 1995)		
9	Peptide & Protein Drug Delivery by FrokjaerMunksgaard International Publishers; 1st edition (October 1998).		
10	Peptide and Protein Drug Delivery by Vincent H. L. Lee (Editor) Marcel Dekker, (November 19, 1990)		
11	Protein Formulation and Delivery Series Volume: 99 Edited By: Eugene McNally 1999.		
12	Drug Delivery to the Lung by Hans Bisgaard (Editor), Chris O'Callaghan (Editor), Gerald C. Smaldone (Editor) Marcel Dekker; 1st edition (January 15, 2002)		
13	Trends and Future Perspectives in Peptide and Protein Drug Delivery (Drug Targeting and Delivery) by MisturuHashida, Yutaka Mizushima (Editor), V. Lee (Editor)		

14	Liposomes in Biomedical Applications (Drug Targeting and Delivery) by Pang N. Shek (Editor) Taylor & Francis; (September 1, 1995).	
15	Drug Targeting Technology, Physical-Chemical-Biological Methods Series Volume: 115 Edited By: Hans Schreier, Marcel Dekker 2001.	
16	Handbook of Biodegradable Polymers (Drug Targeting and Delivery) by A. J. Domb (Editor), Joseph Kost (Editor), David M. Wiseman (Editor) 2001	
17	Bio-related Polymers and Gels: Controlled Release and Applications in Biomedical Engineering by Teruo Okano (Author) AcademciPrss; 1st edition (May15, 1998)	
18	Smart Polymers for Bioseparation& Bioprocessing by Bo Mattiasson (Editor), Igor Galaev (Editor), Kenneth Katzer, Harwood Academic Pub; 1st edition (June 15, 2002)	
19	Cordonary artery Stenting ed. S Golberg, Cooper Synergy Blackwell, 2001	
Course Outcomes (students will be able to…..)		
1	Understand various approaches for the development of parenteral drug delivery system	
2	Understand various approaches for the development of peptide drug delivery system	
3	Understand various approaches for the development of Colloidal drug delivery system	
4	Understand various approaches for the development of Pulmonary drug delivery system	
5	Understand various aspects in the development of targeted drug delivery system	

	Course Code: PHT 2107	**Course Title: Targeted Drug Delivery**	**Credits = 3**		
			L	**T**	**P**
	Semester: II	**Total contact hours: 45**	**2**	**1**	**0**
List of Prerequisite Courses					
	B. Pharm courses (Pharmaceutics) and M. Pharm courses (Drug delivery system-I) of ICT or equivalent				
List of Courses where this course will be prerequisite					
Description of relevance of this course in the M. Pharm Program					
To train the students to design drug delivery systems for passive and active targeting					

Sr. No.	**Course Contents (Topics and subtopics)**	**Reqd. hours**	
		L (30)	**T (15)**
1	Introduction to Targeted Drug Delivery Concept of drug targeting, basis for drug targeting, need for targeting, the physicochemical and physiological basis of targeting, RES	6	3
2	Receptor mediated drug targeting	6	3
3	Colon targeting approaches and DDS	4	2
4	Targeting to the brain	3	2
5	Targeting in cancer and infectious diseases	8	3
6	Ligands for targeted delivery. Monoclonal antibodies in targeted delivery	3	2
List of Text Books/ Reference Books			
1	Drug targeting : organ specific strategies: By GrietjeMolema, D. K. F. Meijer 2001		
2	Targeted drug deliveryKenneth L. Audus, R. L. Juliano Springer-Verlag, 1991		

3	Drug targeting: strategies, principles, and applications By G. E. Francis, Cristina Delgado Humana Press 2000	
4	Brain drug targeting: the future of brain drug development By William M. PardridgeCembridge university press 2001	
5	Biomedical aspects of drug targeting By Vladimir Muzykantov, V. P. Torchilinkluwer Academic publishers 2002	
6	Allosteric receptor modulation in drug targeting N. G. Bowery	
7	Targeting of drugs 6: strategies for stealth therapeutic systems By Gregory Gregoriadis, Brenda McCormack, North Atlantic Treaty Organization. Scientific Affairs Division	
8	Enhancement in Drug DeliveryElkaTouitou, Brian W. Barry CRC Press, 2006	
9	Tumor targeting in cancer therapy By Michel Pagé Humana Press 2002	
10	Advances in targeted cancer therapyBy Richard M. Schultz BirjhauserVerlag 2005 Immunotherapy for infectious diseases By Jeffrey M. Jacobson Humana Press 2002	
11	Pharmaceutical Perspectives of Cancer Therapeutics By Ram I. Mahato, Yi Lu Springer Science + Business Media 2009.	
12	Therapeutic Monoclonal Antibodies: From Bench to Clinic By ZhiqiangAn Johan Wiley and Sons 2009.	
13	Development of Methods for Carrier-Mediated Targeted Delivery of Antiviral Compounds Using Monoclonal AntibodiesMarcia I Dawson, Robert W Sidwell, Bill B Barnett, SRI INTERNATIONAL MENLO PARK CA.	
Course Outcomes (students will be able to…..)		
1	Understand various approaches for the development of targeted drug delivery system	
2	Understand various approaches for receptor mediated drug targeting	
3	Understand targeting of drugs to brain, colon	
4	Understand targeting in cancer and infectious diseases	
5	Understand ligands, monoclonal antibodies for targeted delivery	

	Course Code: PHP 2506	**Course Title: Advanced Pharmaceutics Laboratory**	**Credits = 3**		
			L	**T**	**P**
	Semester: II	**Total contact hours: 90**	**0**	**0**	**6**
List of Prerequisite Courses					
	B. Pharm courses (Pharmaceutics) and M. Pharm courses (Drug delivery system-I) of ICT or equivalent				
List of Courses where this course will be prerequisite					
Description of relevance of this course in the M. Pharm Program					
To train the students on solubilization techniques and formulation of drug delivery systems					
Sr.	**Course Contents (Topics and subtopics)**		**Reqd. hours**		

No.		
1	Preparation andPhysicochemical evaluation of:	
a.	Drug excipient interaction by DSC	3
b.	Solid dispersions using two techniques and their comparative evaluation	9
c.	Colonic DDS- Pelletisation by extrusion spheronisation and coating	12
d.	Oral microemulsions/SMEDDS, ternary phase diagrams	9
e.	Mucoadhesive DDS/ Transdermal DDS – Films	9
f.	Controlled release gels- nasal/ophthalmic	9
g.	Nanoparticles – SLN/ Inorganic/Polymeric	9
	APIs will be selected from among synthetic and biotechnology derived molecules for	
2	Dissolution testing of CR tablets and fitting to various models	9
3	Validation of dissolution apparatus, demonstration of USP Apparatus IV	9
4.	QBD enabled development of an oral osmotic DDS	12
List of Text Books/ Reference Books		
1	Excipient Applications in Formulation Design and Drug Delivery, Drug excipient interaction, chapter 2, Springer International Publishing Switzerland 2015	
2	Controlled Release in Oral Drug Delivery (Advances in Delivery Science and Technology), Springer publisher	
3	Y W. Chien, Novel Drug Delivery Systems, 2nd edition, revised and expanded, Marcel Dekker, Inc., New York, 1992	
Course Outcomes (students will be able to…..)		
1	Understand basics of drug excipient interaction	
2	Understand solid dispersions	
3	Understand colonic drug delivery system	
4	Understand microemulsifying drug delivery	
5	Understand lipid, polymeric drug delivery system	
6	Understand mucoadhesive, transdermal drug delivery system	
7	Understand various aspects of dissolution testing	
8	Understand QbD	

NEW / MODIFIED COURSES
BRANCH - PHARMACEUTICAL CHEMISTRY

SEMESTER I

	Course Code: PHT 2101	Course Title: Research Methodology	Credits = 3		
			L	T	P
	Semester: I	Total contact hours: 45	2	1	0
List of Prerequisite Courses					
List of Courses where this course will be prerequisite					
Description of relevance of this course in the M. Pharm / M. Tech. Program					

Sr. No.	Course Contents (Topics and subtopics)	Reqd. hours
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 5. Title – Title of project with author’s name 6. Abstract – Statement of the problem Background list in brief and purpose and scope 7. Key-words- 8. 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	
14	Presentation (Specially for oral) • 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	
15	Protection of patents and trade marks, Designs and copyrights • 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	
16	Sources for procurement of Research Grants	
17	Industrial- Institution Interaction - Industrial projects – Their feasibility reports	
List of Text Books/ Reference Books		
1	Research in Education – Johan V. Best James V. Kahn	
2	Presentation skills- Michael Halton- Indian Society for Institute Education	
3	A Practical Introduction to copy right – Gavin Mcfarlane	
4	Thesis projects in Science and Engineering – Richard M. Davis	
5	Scientists in legal system – Ann labor science	
6	Thesis and Assignment writing – Jonathan Anderson	
7	Writing a technical paper- Donald Menzel	
8	Effective Business Report writing – Leland Brown	
9	Protection of Industrial property rights- Purushottam Das and Gokul Das	
10	Spelling for the million – Edna furmess	
11	Preparing for publication – King Edwards Hospital fund for London	
12	Information technology – The Hindu speaks	
13	Documentation – Genesis & Development 3792	
14	Manual for evaluation of Industrial projects – United Nations	
15	Manual for the preparation of Industrial feasibility studies	
Course Outcomes (students will be able to…..)		
1		
2		

	Course Code: PHT 2201	Course Title: Advanced Organic Chemistry	Credits = 3		
			L	T	P
	Semester: I	Total contact hours: 45	2	1	0

List of Prerequisite Courses		
	B.Pharm courses (Organic Chemistry I, Organic Chemistry II, Organic Chemistry III) of ICT or equivalent	

List of Courses where this course will be prerequisite		

Description of relevance of this course in the M. Tech. Program

Students will be exposed to recent advances in organic chemistry and its applications in pharmaceutical industry.

Sr. No.	Course Contents (Topics and subtopics)	Reqd. hours
1	Recapturing earlier (This is to refresh the organic chemistry studied so far and which is relevant to subsequent topics): Organic intermediates (carbocations, carbanions, free radicals, carbenes and nitrenes. Their method of formation, stability and synthetic applications), Types of reaction mechanisms and methods of determining them, Detailed knowledge regarding the reactions, mechanisms and their relative reactivity and orientations. Addition reactions: Nucleophilic uni- and bimolecular reactions (SN1 andSN2), Elimination reactions (E1 & E2; Hoffman &Saytzeff'srule), Rearrangement reaction, along with stereochemistry Synthetic Methodologies Frequently used in drug synthesis with emphasis on recent developments in oxidation, reduction, carbon-carbon bond forming reactions including organometallic and palladium based methods, Protection and deprotection methods.	4+2 2+1 2+1
2	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, continuous flow reactors (Working principle, advantages and synthetic applications)	6+2
3	i. Retrosynthetic analysis and design of synthetic route and suggestion of approximate reaction conditions: concept, synthon-regents, FGI, Building block based strategies with illustrative exampes of drugs of current interests ii. Retrosynthetic 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.	7+3 3+2
4	Asymmetric synthesis; fundamental principles, asymmetric induction, discussion of classic methodologies.	2+1
5	Discussion of any four classic total syntheses of bioactive natural products.	4+3

List of Text Books/ Reference Books

1	Advanced Organic Chemistry, 4th Ed., Parts A and B, Carey F. A and Sundberg, R. J.
2	Chirotechnology, industrial synthesis of optically active compounds, Sheldon R.A.
3	Textbook of Drug Design and Discovery, Krogsgaard-Larsen P, Liljefors, T, Madsen U
4	Advanced Organic Chemistry, March J.
5	Combinatorial Chemistry: Synthesis and Applications, Wilson S. R. and Czamik A
6	Organic Synthesis, The disconnection Approach, Warren S
7	Synthon Approach, Iyer R.P et.al.
8	Organic Chemsitry, J. Clayden
9	The Logic of Chemical Synthesis, E.J. Corey
10	Classics in Total Synthesis, K.C. Nicolou and E.J. Sorensen

Course Outcomes (students will be able to…..)

1	Write Mechanisms and appreciate newer aspects of chemistry including stereochemistry and analytics	
2	Principles and applications of green chemistry	
3	Principles and applications of restrosynthesis	
4	Concept of asymmetric synthesis	
5	Principles of total synthesis of bioactive natural products	

	Course Code: PHT 2202	**Course Title: Advanced Medicinal Chemistry – I**	**Credits = 3**		
			L	**T**	**P**
	Semester: I	**Total contact hours: 45**	**2**	**1**	**0**
List of Prerequisite Courses					
	Pharmaceutical and Medicinal Chemistry I-V of ICT B.Pharm course or equivalent				
List of Courses where this course will be prerequisite					
	Advanced Medicinal Chemistry –II				
Description of relevance of this course in the M. Pharm / M. Tech. Program					
In depth understanding of the concepts of drug discovery and design with respect to ADMET properties					

Sr. No.	**Course Contents (Topics and subtopics)**	**Reqd. hours**
1.	Introduction to Historical and Modern Drug Discovery- Sources of drugs/leads • Serendipity, random screening, natural sources, analogue based design • Rational drug design • Techniques and tools in modern drug discovery • Introduction to QSAR, SBDD and LBDD • Concepts of privileged structures and chemical diversity	4+2
2.	Physicochemical and Biopharmaceutical Properties of Drug Substances and Pharmacokinetics (ADMET for drugs) • Lipinski 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+3
3.	Drug Metabolism Chemistry Phase I and II reactions including mechanisms. In silico methods for predicting drug metabolism Metabolic soft spots, Design of drugs to modify metabolism Rationale and practical considerations of prodrug design.	5+3
4.	Drugs acting by enzyme inhibition, Types of Enzyme Inhibitors including Rapid Reversible inhibitors, Transition state inhibitors, Pseudo irreversible and Mechanism based inhibitors, MichelisMenten Kinetics and plotting enzyme kinetics data. Examples to include: ACE inhibitors, Renin inhibitors, HMG-Co reductase inhibitors, HIV-reverse transcriptase, protease and integrase inhibitors, cyclooxengase, leukotrienes and lipoxygenase inhibitors, aromatase inhibitors and DHFR inhibitors. .	7+3
5.	Drugs acting on receptors Receptors, four superfamilies, binding and activation, theories of drug receptor interaction,	4+2

	drug receptor interactions, agonists vs antagonists Examples with respect to different classes of receptors	
6.	Stereochemistry and Drug action: Realization that stereo selectivity is a pre-requisite for evolution. Role of chirality in selective and specific therapeutic agents. Case studies, Enantio-selectivity in drug adsorption, metabolism, distribution and elimination.	4+1
7.	Miscellaneous Topic: Concept of Drug resistance, causes, strategies to combat drug resistance in antibiotics and anticancer therapy	1+1
	• 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, GerdFolkers, Richard Guy January 2002. • Essentials of Computational Chemistry: Theories and Models Cramer, C.J. John • Textbook of Drug Design and Discovery, PovlKrogsgaard-Larsen, Ulf Madsen, Kristian Stromgaard, 4th Edition, 2009. Taylor and Francis. • Antitargets: Prediction and Prevention of Drug Side Effects, Roy J. Vaz, Thomas Klabunde, RaimundMannhold, Hugo Kubinyi, GerdFolkers 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, RaimundMannhold, GerdFolkers October 2004. • Chemoinformatics in Drug Discovery by Tudor I. Oprea, RaimundMannhold, Hugo Kubinyi, GerdFolkers, 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.	
List of Text Books/ Reference Books		
1	Advanced Organic Chemistry, 4th Ed., Parts A and B, Carey F. A and Sundberg, R.J.;;	
2	Chirotechnology, industrial synthesis of optically active compounds, Sheldon R.A	

3	Textbook of Drug Design and Discovery, Krogsgaard-Larsen P, Liljefors, T, Madsen U;	
4	Advanced Organic Chemistry, March J.; Combinatorial Chemistry: Synthesis and Applications, Wilson S. R. and Czamik A;	
5	Advanced Organic Chemistry, March J.;	
6	Combinatorial Chemistry: Synthesis and Applications, Wilson S. R. and Czamik A;	
7	Organic Synthesis, The disconnection Approach, Warren S; SynthonApproach ,Iyer R.P et.al.,	
8	Organic Chemsitry, J. Clayden	
9	The Logic of Chemical Synthesis, E.J. Corey	
10	Classics in Total Synthesis, K.C. Nicolou and E.J. Sorensen.	
Course Outcomes (students will be able to…..)		
1	Understanding basics of QSAR, for applications in pharmaceutical sciences.	
2	Understanding basics of physicochemical properties of drugs and their implications	
3	Understanding basics is drug metabolism and its importance in medicinal chemistry	
4	Principles of receptors and their inhibition.	

	Course Code: PHP 2505	**Course Title: Instrumental Methods of Analysis Laboratory**	**Credits = 3**		
			L	**T**	**P**
	Semester: I	**Total contact hours: 90**	**0**	**0**	**6**
List of Prerequisite Courses					
	Pharmaceutical Analysis theory and Lab at Undergraduate level				
	Pharmaceutical Formulation theory at Undergraduate level				
List of Courses where this course will be prerequisite					
	Pharmaceutics, Pharmacology, Pharmaceutical Chemistry and Pharmacognosy Lab in following Sem.-II and the research work				

Description of relevance of this course in the M. Tech. Program

Analysis by instrumental methods is important for all industrial synthesis as well as formulations. Monitoring of processes, raw materials and finished products require instrumental analytical techniques.

Sr. No.	**Course Contents (Topics and subtopics)**	**Reqd. hours**
7.	UV/Visible Spectroscopy xii. Calibration of UV spectrophotometer xiii. Study effect of solvent on wavelength maxima of drugs. xiv. Find Beer's law limit of drugs in a suitable solvent. xv. Standard calibration curve by UV spectroscopy at d) λ max e) λ max + 10 nm f) λ max – 10 nm xvi. Determination of pKa by U.V. spectroscopy. xvii. Multicomponent analysis by UV-Spectrophotometry xviii. Absorbance corrected for interference method xix. Simultaneous equation method xx. Absorbance ratio method xxi. Area under curve method xxii. First derivative spectrophotometric method	24
8.	Analysis of drugs from formulations focusing on separation of drug from the formulation excipients	12
9.	IR Spectroscopy iii. Calibration of IR spectrophotometer iv. Sample preparation for I.R. spectroscopy (solid/liquids) and interpretation of IR bands for	12

	important functional groups.	
10.	DSC analysis of drugs in crystalline and amorphous forms.	12
11.	Chromatography: vii. HPLC calibration of HPLC column and determination of response factor by HPLC iii. GC Instrumental handling and few analyses of the API intermediates ix. TLC mobile phase selection of a various combination of compounds and reaction monitoring. x. Preparative TLC analysis. xi. pH stability evaluation of a drug by TLC. xii. Separation of components by column chromatography.	18
12.	Structural Interpretation by Spectroscopy: ii. Basic interpretations of simple Mass spectra and NMR. v. Structural elucidation workshop: Interpretation of ^{1}H NMR, ^{13}C NMR, IR and Mass spectrometry of simple compounds (maximum 12 carbon atoms).	12
List of Text Books/ Reference Books		
20.	M. Orchin and H.H. Jaffe - Theory and applications of Ultraviolet spectroscopy. (John Wiley and Sons. N.Y).	
21.	Silverstein, Basseler, Morril- Spectrometric identification of organic compounds (John Wiley and Sons. N.Y).	
22.	Willard, Merritt, Dean - Instrumental methods of analysis (CBS Publishers and Distributors, Delhi).	
23.	J.R. Dyer - Application of absorption Spectroscopy of Organic Compounds (Prentice Hall, London).	
24.	C.N.R. Rao - Chemical Applications of Infrared spectroscopy. (Academic Press, N.Y.).	
25.	L.M. Jackmann and B.D. Sternhell - Application of NMR spectroscopy in organic chemistry (Pergamon Press, London.).	
26.	F.W. McLafferty and F. Turecek- Interpretation of Mass Spectra.	
27.	R.J. Hamilton and P. A. Sewell- Introduction to High Performance Liquid Chromatography. (Chapman and Hall, London).	
28.	J.W. Munson- Pharmaceutical Analysis: Modern methods -Part A and Part B (Marcel Dekker, Inc., New York)	
29.	Introduction to Spectroscopy, 3rd edition, Pavia, Lampman, Kriz, Thomson Publisher.	
30.	Analytical chemistry: A Modern Approach to Analytical Science, 2nd edition by Kellner, Mermet, Otto, Valcarcel Wiley ECH.	
31.	Ewing's Analytical Instrumentation Handbook, 3rd edition, edited by Jack, Cazes, Marcel Dekker.	
32.	P.D. Sethi - Quantitative Analysis of Drugs in Pharmaceutical Formulations (VBS Publishers, Delhi).	
33.	Pharmacopoeia of India (latest edition).	
34.	United State Pharmacopoeia (latest edition).	
35.	British Pharmacopoeia (latest edition).	
36.	A.H. Beckett, J.B. Stenlake - Practical Pharmaceutical Chemistry, Part I and Part II (CBS Publishers Delhi)	
37.	F. D. Snell and C. T. Snell- Colorimetric Methods of analysis (Van Nostrand Reinhold Company, N.Y.).	
38.	Journals: Journal of planar chromatography; Actachromatographica. J. Analytical Chemistry.	
Course Outcomes (students will be able to…..)		
6.	Analyze bulk drugs and formulations.	
7.	Perform calibration of analytical instruments.	
8.	Develop chromatographic mobile phases	
9.	Separate the components of the mixtures and either quantify or isolate preparatively	
10.	Interpret the outcomes of the analytical techniques logically to deduce the structure of the	

	compound and/or conclude about the quality/ purity.	

SEMESTER II

	Course Code: PHT 2204	Course Title: Spectroscopy	Credits = 3		
			L	T	P
	Semester: II	Total contact hours: 45	2	1	0
List of Prerequisite Courses					
	Basic knowledge of spectroscopic techniques and instrumentation and physical methods of analysis.				
List of Courses where this course will be prerequisite					
Description of relevance of this course in the M. Tech. Program					
Structure elucidation of compounds using integrated approach of various spectroscopic techniques.					

Sr. No.	Course Contents (Topics and subtopics)	Reqd. hours
	Problems in structure determination using an integrated approach	
1	Application of UV in structure determination and problems	3+1
2	Application of FT-IR in structure determination and problems	1+1
3	Application of NMR (proton) in structure determination and problems	3+1
4	Application of (carbon) in structure determination and problems	3+1
5	Application of Mass spectrometry in structure determination and problems	3+1
	Problems based on UV + Proton NMR + FT-IR	7+3
6	Problems based on UV + Proton and carbon NMR + FT-IR + Mass	9+6
7	Introduction to 2D NMR	1+1
List of Text Books/ Reference Books		
1	Applications of Absorption Spectroscopy of Organic Compounds, John R Dyer;	
2	Organic Structural Spectroscopy, Lambert, J.B., Shurvell H.F., Lightner D.A. and Cooks R.G	
3	Structure Elucidation by Modern NMR, Duddeck H. and Dietrich W., Steinkopf	
4	Mass Spectrometry, Principles and Applications, Williams D.H. and Bowen R	
5	Spectroscopic Identification of Organic Compunds, R.M. Silverstein, G.C. Basslrer, T.C. Morrill	
6	Carbon-13 NMR spectroscopy, E. Breitmeir and W. Voelter.	
Course Outcomes (students will be able to…..)		
1	Introduce the theory of the various instruments and the signals produced when analysing compound	
2	Equip the student with enough information to be able to interpret signals from spectroscopic instruments.	
3	Use NMR spectra, in conjunction with infrared and mass spectra, to elucidate and substantiate the molecular structure of organic compounds.	

	Course Code: PHT 2206	Course Title: Advanced Pharmaceutical Chemistry	Credits = 3		
			L	T	P
	Semester: II	Total contact hours: 45	2	1	0
List of Prerequisite Courses					
	Organic Chemistry, Pharmaceutical chemsitry courses of ICT or equivalent				
List of Courses where this course will be prerequisite					
	-				
Description of relevance of this course in the M. Pharm / M. Tech. Program					
Students will be exposed to recent advances in organic chemistry and its applications in pharmaceutical industry.					

Sr. No.	Course Contents (Topics and subtopics)	Reqd. hours
1	Solid phase synthesis: Concept, resins, linkers, characterizations, examples.	3+2
2	Peptide synthesis: Protected amino acids, coupling agents, strategies in synthesis with examples of peptide drugs and hormones. Solid phase synthesis and peptide synthesizers.	3+1
3	Oligonucleoside Synthesis: Methodologies, solid phase oligonucleosides synthesis.	2+1
4	Combinatorial synthesis: liquid phase and solid phase, deconvolution techniques, design of libraries, these to be discussed with illustrative examples of combinatorial libraries.	1+1
5	Organic nanomaterials (Single molecular and molecular assemblies): Design, synthetic strategies, characterisation and properties. E.g. dendrimers, polymeric nanomaterials, carrier-systems for drug targeting.	4+2
6	Fluorescent and imaging materials: Design and synthesis, properties and applications.	2+1
7	Photochemical Reactions: Basic principles of photochemical reactions. Photo-oxidation, photo-addition and photo-fragmentation.	3+1
8	Organic Name Reactions (Ugi reaction, Brook rearrangement, Ullmann coupling reactions, Mitsunobu reaction, Sharpless asymmetric epoxidation and dihydroxylation, Metathesis)	4+2
9	Synthetic Reagents & Applications: Aluminiumisopropoxide, *N*-bromosuccinamide, diazomethane, dicyclohexylcarbodimide, Wilkinson reagent, Wittig reagent. osmium tetroxide, titanium chloride, diazopropane, diethyl azodicarboxylate, triphenylphosphine, benzotriazol-1-yloxy) tris (dimethylamino) phosphoniumhexafluoro-phosphate (BOP)	8+4

List of Text Books/ Reference Books		
1	Advanced Organic Chemistry, 4th Ed., Parts A and B, Carey F. A and Sundberg, R. J.	
2	Chirotechnology, industrial synthesis of optically active compounds, Sheldon R.A.	
3	Textbook of Drug Design and Discovery, Krogsgaard-Larsen P, Liljefors, T, Madsen U	
4	Advanced Organic Chemistry, March J.	
5	Combinatorial Chemistry: Synthesis and Applications, Wilson S. R. and Czamik A	
6	Organic Synthesis, The disconnection Approach, Warren S	
7	Synthon Approach, Iyer R.P et.al.	
8	Organic Chemsitry, J. Clayden	
9	The Logic of Chemical Synthesis, E.J. Corey	
10	Classics in Total Synthesis, K.C. Nicolou and E.J. Sorensen	
Course Outcomes (students will be able to…..)		
1	Concept of peptide chemistry	
2	Concept of combinatorial chemistry	
3	Understanding of organic nanomaterials and fluorescent and imaging materials	
4	Concept of Photochemical reactions	
5	Application of selected name reactions	

	Course Code: PHT 2205	Course Title: Advanced Medicinal Chemistry – II	Credits = 3		
			L	T	P
	Semester: 1I	Total contact hours: 45	2	1	0
List of Prerequisite Courses					
	Advanced Medicinal Chemistry- I				
	Advanced Organic Chemistry				
List of Courses where this course will be prerequisite					
Description of relevance of this course in the M. Pharm / M. Tech. Program					
This course deals with drug design techniques in medicinal chemistry and is very relevant to new drug discovery of small molecules.					

Sr. No.	Course Contents (Topics and subtopics)	Reqd. hours
1	2-D QSAR • History and development of 2-D QSAR • Parameters – lipophilicity and related parameters, electronic parameters, steric parameters, other parameters • 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	4+2
2	Molecular Mechanics and Energy Minimization • 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	4+2
3	Docking by different techniques.	3+1
4	Pharmacophore Modelling 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 using pharmacophores.	5+3
5	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 Examples from literature and programs available to be discussed	3+2
6	3-D QSAR approaches CoMFA and CoMSIA, brief discussion on other methods like MSA, RSA and HASL methods Limitations of QSAR.	3+1
7	Peptidomimetics Therapeutic values of Peptidomimetics, design of peptidomimetics by manipulation of the amino acids, modification of the peptide backbone, incorporating conformational constraints locally or globally. Chemistry of prostaglandins, leukotrienes and thromboxones.	3+1
8	Case studies of recent Drug Discovery based on a) Structure based along design d) Receptor agonists / antagonists	5+3

	b) Ligand based drug design e) Fragment based drug design c) Enzyme inhibitors f) SAR / QSAR/ analog design	
List of Text Books/ Reference Books		
1	All references in Advanced Medicinal Chemistry I	
2	Enzymes, Dixon M and Webb E. C., 3rd Ed., Longman Group Ltd., 1979.	
3	Lehninger, Principles of Biochemistry, Nelson D. L. & Cox M.M, 3rd Ed., Replika Press Pvt. Ltd., India, 2000	
4	Biochemistry, Stryer L, 3rd Ed. W.H. Freeman & Co,. N.Y, 1988.	
5	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.	
6	Textbook of Drug Design and Discovery, PovlKrogsgaard-Larsen, Ulf Madsen, Kristian Stromgaard, 4th Edition, 2009. Taylor and Francis.	
7	Cell Surface Receptors: A Short Course on Theory and Methods, Limbird, L.E., Nijhoff, Boston, 1986.	
8	Drug Development, Hamner C. E., Ed., 2nd Ed., CRC Press, Boca Raton, 1990.	
9	Pharmacologic Analysis of Drug-Receptor Interaction, Kenakin, T.P., Raven, N.Y., 1987.	
10	Principles in General Pharmacology, Tallarida, R.J., Raffa, R.B. and McGonigle P., Springer-Verlag, N.Y., 1988.	
11	Receptor Pharmacology and Function, Williams, M., Glennon, R.A. and Timmermans P.B.M.W.M, Eds, Marcel Dekker, N.Y., 1988.	
Course Outcomes (students will be able to…..)		
1	Design new potential therapeutic molecules using structure based drug design	
2	Design new potential therapeutic molecules using ligand based drug design	
3	Understand peptide and prostaglandin chemistry	

	Course Code: PHP 2507	Course Title: Advanced Pharmaceutical and Medicinal Chemistry Laboratory	Credits = 3		
			L	T	P
	Semester: II	Total contact hours: 90	0	0	6
List of Prerequisite Courses					
	Basic laboratory techniques of unit process and operations.				
List of Courses where this course will be prerequisite					
Description of relevance of this course in the M. Pharm / M. Tech. Program					
General Laboratory Experience of scale up of an API or intermediate. Separation techniques					

Sr. No.	Course Contents (Topics and subtopics)	Reqd. hours
1	Measurement of logP of a poorly water soluble and a highly water soluble drug	6
2	Determination of the pKa of a drug (weak acid and weak base) by potentiometric titration and/or by UV/visible spectroscopy	6
3	Measurement of Vmax and Km of a hydrolase enzyme.Plotting data by Linweaver Burke and EadieHofstee methods.	6
4	2D and 3DQSAR based experiments using CADD	6
5	Docking and virtual screening using CADD	12
6	Synthesis of 4 drugs and/or intermediates (for e.g. thiazide and hydrothiazide derivatives, metformin, meclizine, cyclizine, cinnarazine, flunarzine etc.) involving multistep reactions, (Students to learn monitoring the reactions by TLC, separate the main product from impurities by column chromatography and characterize products and impurities by spectroscopic and chromatographic techniques)	30
7	Microwave irradiated reactions of synthetic importance (any two)	6
8	Resolution of racemic mixtures of acidic and basic compounds by formation of diastereomers	12
9	Synthesis of prodrugs of any one of the common drugs and study of their decomposition (kinetics) to the parent drug (suggest use of DCC based coupling to obtain ester prodrugs)	6

List of Text Books/ Reference Books		
1	Furniss, Brian S. Vogel's textbook of practical organic chemistry, Pearson Education India,	
2	J. Leonard, trvor P. Toube, B. Lygo, G Advanced Practical Organic Chemistry. Proctor, 2nd edition, Stanley Thornes. 1990	
3	Keese, R, Martin P. B, and Trevor P. Toube. Practical organic synthesis: a student's guide. John Wiley & Sons, 2006.	
Course Outcomes (students will be able to…..)		
1	Exposure to process development	
2	Knowledge of Green chemistry, hazards, effluents and statistical methods of optimizations	
3	Knowledge of process variables and implication in scale up	

NEW / MODIFIED COURSES
BRANCH- MEDICINAL AND NATURAL PRODUCTS

SEMESTER I

	Course Code: PHT 2101	Course Title: Research Methodology	Credits = 3		
			L	T	P
	Semester: I	Total contact hours: 45	2	1	0
List of Prerequisite Courses					
List of Courses where this course will be prerequisite					
Description of relevance of this course in the M. Pharm / M. Tech. Program					

Sr. No.	Course Contents (Topics and subtopics)	Reqd. hours
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 9. Title – Title of project with author's name 10. Abstract – Statement of the problem Background list in brief and purpose and scope 11. Key-words- 12. 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	
14	Presentation (Specially for oral) • 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	
15	Protection of patents and trade marks, Designs and copyrights • 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	
16	Sources for procurement of Research Grants	
17	Industrial- Institution Interaction - Industrial projects – Their feasibility reports	
List of Text Books/ Reference Books		
1	Research in Education – Johan V. Best James V. Kahn	
2	Presentation skills- Michael Halton- Indian Society for Institute Education	
3	A Practical Introduction to copy right – Gavin Mcfarlane	
4	Thesis projects in Science and Engineering – Richard M. Davis	
5	Scientists in legal system – Ann labor science	
6	Thesis and Assignment writing – Jonathan Anderson	
7	Writing a technical paper- Donald Menzel	
8	Effective Business Report writing – Leland Brown	
9	Protection of Industrial property rights- Purushottam Das and Gokul Das	
10	Spelling for the million – Edna furmess	
11	Preparing for publication – King Edwards Hospital fund for London	
12	Information technology – The Hindu speaks	
13	Documentation – Genesis & Development 3792	
14	Manual for evaluation of Industrial projects – United Nations	
15	Manual for the preparation of Industrial feasibility studies	
Course Outcomes (students will be able to…..)		
1		
2		

	Course Code: PHT 2301	Course Title: Pharmacognosy and Phytochemistry	Credits = 3		
			L	T	P
	Semester: I	Total contact hours: 45	2	1	0
List of Prerequisite Courses					
	Pharmacognosy-I, II, III of ICT B Pharm Syllabus or any equivalent course				
List of Courses where this course will be prerequisite					
	All pharmacognosy, phytochemistry and medicinal natural product courses				

Description of relevance of this course in the M. Pharm / M. Tech. Program

To train the students with the advance pharmacognosy and phytochemistry

Sr. No.	Course Contents (Topics and subtopics)	Reqd. hours	
		L (30)	T (15)
1	(i) Various aspects of cultivation, processing and propagation of medicinal plants of medicinal plants of commercial importance as exemplified by the following examples a) Dioscorea (b) Digitalis (c) Senna (d) Vinca (e) Taxus bravifolia (f) Gineseng (g) Aloes	7	3
2	Newer techniques of plant propagation including plant tissue culture for production of secondary metabolites. - Introduction to Transgenic Plants	2	1.5
3	Introduction to alternate systems of Medicine viz.- Chinese, Tibetan, Homeopathy, Ayurveda, Unani and Siddha and Aromatherapy.	2	1.5
4	i. Techniques of extraction including supercritical fluid extraction and other Advanced technology. ii. Large scale extraction of phytochemicals as exemplified by the following examples (i) Diosgenin (ii) Pyrethrins (iii) Taxol (iv) Opium alkaloids (v) Curcuminoids	7	3
5	Study of the following Classes of natural products (a) Natural Colors as exemplified by saffron, cochineal, Annato (b) Natural Antimicrobials as exemplified by:- i) Benzoic acid from butter fat ii) Propinoic acid from butter fat iii) Tannins such as gallic acid and ellagic acid iv) Anthocyanins from grape and strawberry v) Essentials oils containing terpenes, carvacrol and thymol – Lemon grass, mint caraway Fennel, Anise, cardamom. (c) Natural Pesticides – Neem, tobacco, Pyrethrum (d) Phytoalexines as exemplified by i) Reserated from grape ii) Allixin from garlic iii) Brassinin from cabbage (e) Photo-toxic plants as exemplified by i) Hypericumperforatum ii) Fagopyrumesculantum iii) Psoraleacorylifera (f) Allelolo chemicals as exemplified by i) Juglone from bark of Juglansnigra ii) Chlorogenic acid, isochlorogenic acid found in soyabean, cotton	7	3
6	Aflatoxins:- Introduction, Different fungi producing aflatoxin affecting production, structure of Aflatoxin and their biosynthesis, spoilage in crops and seeds due to aflatoxin and its prevention, neurotoxicity due to aflatoxin.	5	3

List of Text Books/ Reference Books		
1	Pharmacognosy Phytochemistry – Medicinal Plants – Jean Brunetton, Lavoisier Publising, Paris	
2	Text Book of Pharmacognosy – Trease& Evans – 14th edition	
3	Transgenic Plants – R. Ranjan- Published by Agro Botanica, New Delhi	
4	Transgenic Plants – A Production system for Industrial and Pharmaceutical Proteins	
5	Ed. By Meran Owen, Jan Pen – Published by John Wiley.	
6	Encyclopaedia of Tibetan medicine vol. I to V. – Vaidya Bhagwan Dash – Published by Sri Satguru Publisher	
7	Medicinal Plant – Their Bioactivity, Screening and Evaluation – Published by CSIR	
8	Textbook of Pharmacognosy – Trease and Evans – 14th edition	
9	Principles of Ayurvedic Therapeutics – Kumar A. V. –Sri Satguru Publications	
10	MateriaMedica of Homeopathic Medicines – Phatak S. R.	
11	Homeopathic Pharmacopoeia of India of India – Published Ministry of Health	
12	The Ayurvedic formulary of India. Part I & II- Published by Ministry of Health	
13	Chinese MateriaMedica- You- PinZhu- Harwood Academic Publishers	
14	India Materia Meidca – Nadkarni A. K. – Bombay Popular Prakashan	
15	Phytochemical Methods – J. B. Harbone	
16	Cultivation's and Processing of Medicinal Plants – Ed. By L. Hornok – published by John Wiley	
17	Introduction to Flavonoids – Bohrn Bruce A. – Published by Harwood Academic Publishers	
18	Cultivation and Utilization of Aromatic Plants – Ed. By Atalc.K. &Kapur B. M.- Published by CSIR	
19	Plant Tissue and Cell Culture Ed. H. E. Street- Blackwell Scientific Publications.	
20	Alfatoxin – Leo A. Gold Blatt – Academic Press New York.	
21	Food Additive – R. J. Taylor	
22	Micotoxin in Humna Health – I. F. Purchase	
23	Pharmacology and Toxicology of natural occurring toxin – International Enxyclopedia of Pharmacology and Therapeutic	
24	Microbial Toxins – Ciejler, Kadis and Ajl- Academic Press	
25	Antimicrobial in food- Alfred Larry Branen, P. Michael Davidson. Publishing Corporation	
Course Outcomes (students will be able to…..)		
1	Understand the complexity of herbal drug extraction, isolation and analysis and find out the appropriate and scientific solution for the same	
2	Undertake extraction and isolation of phytochemicals using different techniques	
3	Identify commercially important plant materials, natural colors and pesticides	
4	Study natural different toxic compounds	
5	Understand different methods of cultivation as well as tissue culture techniques	

	Course Code: PHT 2302	**Course Title: Pharmacology, Toxicology and Therapeutics**	**Credits = 3**		
			L	**T**	**P**
	Semester: I	**Total contact hours: 45**	**2**	**1**	**0**
List of Prerequisite Courses					
	Anatomy, Physiology and Pathology-I, II and Pharmacology I, II, III, IV of ICT B Pharm syllabus or any equivalent course.				

List of Courses where this course will be prerequisite		
	Drug discovery, regulatory affairs and clinical trials	
Description of relevance of this course in the M. Pharm / M. Tech. Program		

Sr. No	**Course Contents (Topics and subtopics)**	**Reqd. hours**	
		L (30)	**T (15)**
1	Evaluation of Drug activities- Pharmacometrics Primary screening for evaluating potential drugs.	3	2
2	Different approaches- factors affecting the programs. Primary general tests and selected special test- Design statistical analysis and Interpretation. Randomization.Different experimental designs Distribution free statistical test including wilcoxon signed rank test, friedman's test. Kruskal and wallis test. Strain and sex differences in response to drug. Limitation of animal test and transfer of data from animal to man.	7	3
3	Clinical trials – Drug registration	4	2
4	Study of models for testing a) Analgesics b) Antipyretic c) Anti-inflammatory d) Anticancer e) Antihypertensive f) Diuretics g) Purgatives h) Antidepressant and ant anxiety i) Hypoglycemic agents	7	3
5	Toxicity: ICH and OECD Guidelines	3	2
6	Importance of Transgenic animal models / knock out mice in screening methods	3	1
7	An overview of regulatory status – Ethical / moral / professional / issues in toxicity	3	2

List of Text Books/ Reference Books	
1	Screening methodology in Pharmacology-II by Turner &Hebborn
2	Mutagenicity testing & related analytical Techniques by R. W. Frei& U. A. Th. Brinkman
	Evaluation of drug activities by Laurence & Bacharach – Vol. I & II
4	In vitro toxicity testing by John M Fraizer
5	Microbial resistance to drugs by L. E. Bryan
6	Combination drug: Their use & regulation – Louis Lasanga
7	Receptors based drug design by Paul left.
8	Drug discovery The evolution of modern medicines by Walter Sneader
9	Psychopharmacology: The 3rd generation & progress by Herbert Y. Meltzer
10	Psychoactive drugs: tolerance & sensitization
11	Drug receptors & their effectors edited by Nigel J. M. Birdsall
12	Textbook of Receptor Pharmacology by John c. Foreman, Torben Johansen
13	Scientific basis of drug dependence by Hannah Steingerg
14	Hypersensitivity to drugs Vol. I by Max Samter& C. W. Parker
15	Receptor binding in drug research by Robert A O'Brien
16	Drug Receptors by H. P. Raug
17	General & Applied Toxicology by Bryan Ballantyne T. Marrs& P. Turner
18	Safety evaluation of Drugs & Chemicals by W. Eugene Lloyd
19	Pharmacology 3rd Edition – H. P. Rang & M. M. Dale
Course Outcomes (students will be able to…..)	
1	Analyse a data by applying relevant statistical tests and interpret the same.

2	Design a protocol to evaluate a drug for its efficacy.	
3	Understand ICH and OECD guidelines for toxicity study.	
4	Know the ethical consideration for a drug trial and its registration.	

	Course Code: PHP 2505	Course Title: Instrumental Methods of Analysis Laboratory	Credits = 3		
			L	T	P
	Semester: I	Total contact hours: 90	0	0	6

	List of Prerequisite Courses	
	Pharmaceutical Analysis theory and Lab at Undergraduate level	
	Pharmaceutical Formulation theory at Undergraduate level	
	List of Courses where this course will be prerequisite	
	Pharmaceutics, Pharmacology, Pharmaceutical Chemistry and Pharmacognosy Lab in following Sem.-II and the research work	

Description of relevance of this course in the M. Tech. Program

Analysis by instrumental methods is important for all industrial synthesis as well as formulations. Monitoring of processes, raw materials and finished products require instrumental analytical techniques.

Sr. No.	Course Contents (Topics and subtopics)	Reqd. hours
13.	UV/Visible Spectroscopy xiii. Calibration of UV spectrophotometer xiv. Study effect of solvent on wavelength maxima of drugs. xv. Find Beer's law limit of drugs in a suitable solvent. xvi. Standard calibration curve by UV spectroscopy at g) λ max h) λ max + 10 nm i) λ max – 10 nm xvii. Determination of pKa by U.V. spectroscopy. xviii. Multicomponent analysis by UV-Spectrophotometry xix. Absorbance corrected for interference method xx. Simultaneous equation method xxi. Absorbance ratio method xxii. Area under curve method xiii. First derivative spectrophotometric method	24
14.	Analysis of drugs from formulations focusing on separation of drug from the formulation excipients	12
15.	IR Spectroscopy v. Calibration of IR spectrophotometer vi. Sample preparation for I.R. spectroscopy (solid/liquids) and interpretation of IR bands for important functional groups.	12
16.	DSC analysis of drugs in crystalline and amorphous forms.	12
17.	Chromatography: iii. HPLC calibration of HPLC column and determination of response factor by HPLC iv. GC Instrumental handling and few analyses of the API intermediates xv. TLC mobile phase selection of a various combination of compounds and reaction monitoring. vi. Preparative TLC analysis. vii. pH stability evaluation of a drug by TLC. iii. Separation of components by column chromatography.	18
18.	Structural Interpretation by Spectroscopy: v. Basic interpretations of simple Mass spectra and NMR. vi. Structural elucidation workshop: Interpretation of ^{1}H NMR, ^{13}C NMR, IR and Mass spectrometry of simple compounds (maximum 12 carbon atoms).	12

	List of Text Books/ Reference Books	
39.	M. Orchin and H.H. Jaffe - Theory and applications of Ultraviolet spectroscopy. (John Wiley and Sons. N.Y).	
40.	Silverstein, Basseler, Morril- Spectrometric identification of organic compounds (John Wiley and	

	Sons. N.Y).	
41.	Willard, Merritt, Dean - Instrumental methods of analysis (CBS Publishers and Distributors, Delhi).	
42.	J.R. Dyer - Application of absorption Spectroscopy of Organic Compounds (Prentice Hall, London).	
43.	C.N.R. Rao - Chemical Applications of Infrared spectroscopy. (Academic Press, N.Y.).	
44.	L.M. Jackmann and B.D. Sternhell - Application of NMR spectroscopy in organic chemistry (Pergamon Press, London.).	
45.	F.W. McLafferty and F. Turecek- Interpretation of Mass Spectra.	
46.	R.J. Hamilton and P. A. Sewell- Introduction to High Performance Liquid Chromatography. (Chapman and Hall, London).	
47.	J.W. Munson- Pharmaceutical Analysis: Modern methods -Part A and Part B (Marcel Dekker, Inc., New York)	
48.	Introduction to Spectroscopy, 3rd edition, Pavia, Lampman, Kriz, Thomson Publisher.	
49.	Analytical chemistry: A Modern Approach to Analytical Science, 2nd edition by Kellner, Mermet, Otto, Valcarcel Wiley ECH.	
50.	Ewing's Analytical Instrumentation Handbook, 3rd edition, edited by Jack, Cazes, Marcel Dekker.	
51.	P.D. Sethi - Quantitative Analysis of Drugs in Pharmaceutical Formulations (VBS Publishers, Delhi).	
52.	Pharmacopoeia of India (latest edition).	
53.	United State Pharmacopoeia (latest edition).	
54.	British Pharmacopoeia (latest edition).	
55.	A.H. Beckett, J.B. Stenlake - Practical Pharmaceutical Chemistry, Part I and Part II (CBS Publishers Delhi)	
56.	F. D. Snell and C. T. Snell- Colorimetric Methods of analysis (Van Nostrand Reinhold Company, N.Y.).	
57.	Journals: Journal of planar chromatography; Actachromatographica. J. Analytical Chemistry.	
Course Outcomes (students will be able to…..)		
11.	Analyze bulk drugs and formulations.	
12.	Perform calibration of analytical instruments.	
13.	Develop chromatographic mobile phases	
14.	Separate the components of the mixtures and either quantify or isolate preparatively	
15.	Interpret the outcomes of the analytical techniques logically to deduce the structure of the compound and/or conclude about the quality/ purity.	

SEMESTER II

	Course Code: PHT 2106	Course Title: Models for Drug Delivery Systems Evaluation	Credits = 3		
			L	T	P
	Semester: II	Total contact hours: 45	2	1	0
List of Prerequisite Courses					
	Anatomy, Physiology and Pathology-I, II and Pharmacology I, II, III, IV of ICT B Pharm syllabus or any equivalent course.				
List of Courses where this course will be prerequisite					
	Pharmaceutical Technology and drug discovery				
Description of relevance of this course in the M. Pharm / M. Tech. Program					

Sr. No.	Course Contents (Topics and subtopics)	Reqd. hours	
		L(30)	T(15)
1	Pharmacodynamic models for evaluation of DDS containing drugs of various categories eg. Cardiovascular agents; Antidiabetic; Antiinflammatory; Antiepileptic; Anticancer; Hepatoprotectives; Analgesics; Antistress; Antiasthmatic and Antitussives etc.	7	3
2	In vitro cell culture techniques for evaluation of drug permeation from DDS including isolation maintenance of cell lines, culturing monolayers, evaluation of drug transport.	7	3
3	*In vitro*/ ex vivo models for evaluation of Drug absorption	3	2
4	*In vitro* cytotoxicity evaluation using cell cultures and techniques such as MTT assay, Dye uptake etc.	6	4
5	Toxicity testing: In-vitro: *In -vitro* toxicity testing and its application to safety evaluation, General perspectives, *in vitro* toxicity trends and issue, Ocular and cutaneous irritation, Validation of In vitro toxicity tests. Acute, sub acute and chronic toxicity testing – Biochemical basis of toxicity, Design of toxicological studies, Quality assurance in toxicology studies, Toxicity by routes – Parental, oral, percutaneous and inhalation, Target organ toxicity exemplified by hepatotoxicity and cutaneous (dermal) toxicity. Regulatory status- Ethical, moral and professional issues.	7	3

List of Text Books/ Reference Books		
1	Bioassay Techniques for drug Development, Atta Ur Rahman, M. Iqbal Choudhary, William J. Thomsen	
2	In vitro Methods in Pharmacuetical Research, Edited by J. V. Casterll, M. J. Gomer, Lechon, Academic Press.	
3	*In Vitro* Toxicity Testing by John M. Fraizer	
4	General and Applied Toxicology by Bryan Ballantyne, T. Marrs& P. Turner	
Course Outcomes (students will be able to…..)		
1	Design an animal model to evaluate a particular drugs/ excipientsefficacy.	
2	Understand cell lines and use cell culture techniques.	
3	Carry out various cell assays to evaluate a drug for its activity.	
4	Design a toxicological study.	

	Course Code: PHT 2303	Course Title: Topics in Pharmacology	Credits = 3		
			L	T	P
	Semester: II	Total contact hours: 45	2	1	0
List of Prerequisite Courses					

	Anatomy, Physiology and Pathology-I & II, Pharmacology I, II, III, IV of ICT B Pharm syllabus or any equivalent course.	
List of Courses where this course will be prerequisite		
	Drug discovery and disease and therapy management	
Description of relevance of this course in the M. Pharm / M. Tech. Program		

Sr. No	**Course Contents (Topics and subtopics)**	**Reqd. hours**	
		L(30)	**T (15)**
1	Biochemical Pharmacology: How Drugs Act: Molecular Aspects Targets for drug action.	7	3
2	Receptors proteins Receptors families: structure and signal transduction mechanisms. • Receptors for fast neurotransmitters • G protein coupled receptors • G proteins and their role • Tyrosine-kinase and guanylatecyclase linked receptors Receptors that regulate DNA transcription	7	3
3	Immunotherapy: immunostimulantsImmunodepressants, cytokines	5	3
4	The Eicosanoids: Prostaglandins, Leukotrienes	4	3
5	Pharmacology of Ca, Na, K, Cl channel modulators	7	3

List of Text Books/ Reference Books		
1	Drug receptors & their effectors edited by Nigel J. M. Birdsall	
2	Textbook of Receptor Pharmacology by John c. Foreman, Torben Johansen	
3	Receptor binding in drug research by Robert A O'Brien	
4	Drug Receptors by H. P. Raug	
5	Pharmacology 3rd Edition – H. P. Rang & M. M. Dale	
6	Immunotherapy by AungNaing	
Course Outcomes (students will be able to…..)		
1	Understand the molecular level mechanism of drug action.	
2	Identify targets for drug action.	
3	Understand various receptors and their signaling mechanisms.	
4	Understand the concept of immunity and drugs acting on same namely immunostimulants, immunodepressants.	

	Course Code: PHT 2304	Course Title:Advanced Pharmacognosy and Phytochemistry	Credits = 3		
			L	T	P
	Semester: II	Total contact hours: 45	2	1	0

List of Prerequisite Courses

	Pharmacognosy-I, II, III and Pharmacognosy and Phytochemistry of ICT B Pharm Syllabus or any equivalent course	

List of Courses where this course will be prerequisite

	All pharmacognosy, phytochemistry and medicinal natural product courses	

Description of relevance of this course in the M. Pharm / M. Tech. Program

To train the students with the advance pharmacognosy and phytochemistry

Sr. No.	Course Contents (Topics and subtopics)	Reqd. hours	
		L (30)	T(15)
1	Systematic Approach to crude drug evaluation and standardization:- i. Literature survey ii. Collection and processing of drug iii. Establishing authenticity of the drug iv. Identifying the part having pharmacological activity of therapeutic significance. v. Suitable processes of extraction and selection of the same vi. Isolation, purification and structure elucidation of the active constituent vii. Isolation of marker compounds and confirming their identity and pharmacological activity. viii. Development of Analytical method for standardization	7	3
2	Herbal drug formulation, standardization and evaluation for safety and efficacy	4	3
3	i. General Biosynthetic pathways in the formation of secondary metabolites. ii. Techniques employed in envestigation of Biogentic studies viz.: - Tracer techniques and studies with respect to isolated tissues, organs and cells. iii. Biosynthesis of phenyl propanoids	5	3
4	Isolation, identification, classification, structure determination and important Pharmacological activities of flavanoids.	7	3
5	Miscellaneous Isoprenoids- i Gentian ii Artemisia iii Santonica flowers iv Coleus Forskohli v Ginkgo biloba vi Carotenoids from different plants as exemplified by capsanthin from capsicum, beta carotene from different sources.	7	3

List of Text Books/ Reference Books

1	Pharmacognosy Phytochemistry – Medicinal Plants – Jean Brunetton, Lavoisier Publising, Paris
2	Text Book of Pharmacognosy – Trease& Evans – 14th edition
3	Transgenic Plants – R. Ranjan- Published by Agro Botanica, New Delhi
4	Transgenic Plants – A Production system for Industrial and Pharmaceutical Proteins
5	Ed. By Meran Owen, Jan Pen – Published by John Wiley.
6	Encyclopaedia of Tibetan medicine vol. I to V. – Vaidya Bhagwan Dash – Published by Sri Satguru Publisher
7	Medicinal Plant – Their Bioactivity, Screening and Evaluation – Published by CSIR
8	Textbook of Pharmacognosy – Trease and Evans – 14th edition
9	Principles of Ayurvedic Therapeutics – Kumar A. V. –Sri Satguru Publications
10	MateriaMedica of Homeopathic Medicines – Phatak S. R.
11	Homeopathic Pharmacopoeia of India of India – Published Ministry of Health
12	The Ayurvedic formulary of India. Part I & II- Published by Ministry of Health
13	Chinese MateriaMedica- You- PinZhu- Harwood Academic Publishers
14	India Materia Meidca – Nadkarni A. K. – Bombay Popular Prakashan
15	Phytochemical Methods – J. B. Harbone

16	Cultivation's and Processing of Medicinal Plants – Ed. By L. Hornok – published by John Wiley	
17	Introduction to Flavonoids – Bohrn Bruce A. – Published by Harwood Academic Publishers	
18	Cultivation and Utilization of Aromatic Plants – Ed. By Atalc.K. &Kapur B. M.- Published by CSIR	
19	Plant Tissue and Cell Culture Ed. H. E. Street- Blackwell Scientific Publications.	
20	Alfatoxin – Leo A. Gold Blatt – Academic Press New York.	
21	Food Additive – R. J. Taylor	
22	Micotoxin in Humna Health – I. F. Purchase	
23	Pharmacology and Toxicology of natural occurring toxin – International Enxyclopedia of Pharmacology and Therapeutic	
24	Microbial Toxins – Ciejler, Kadis and Ajl- Academic Press	
25	Antimicrobial in food- Alfred Larry Branen, P. Michael Davidson. Publishing Corporation	
Course Outcomes (students will be able to…..)		
1	Identify and undertake crude drug evaluation	
2	Understand standardization of formulation	
3	Understand the complexity of herbal drug extraction, isolation and analysis and find out the appropriate and scientific solution for the same	
4	Undertake extraction and isolation of phytochemicals using different techniques	
5	Understand chemistry and formation of bioactive constituents by biosynthetic pathway	
6	Study different flavonoids and isoprenoids	

	Course Code: PHP 2508	**Course Title: Advanced Medicinal Natural Products Laboratory**	**Credits = 3**		
			L	**T**	**P**
	Semester: II	**Total contact hours: 90**	**0**	**0**	**6**
List of Prerequisite Courses					
List of Courses where this course will be prerequisite					
Description of relevance of this course in the M. Pharm / M. Tech. Program					

Sr. No.	**Course Contents (Topics and subtopics)**	**Reqd. hours**
1	Extraction, isolation and evaluation of Berberine from Berberis	6
2	Extraction, isolation and evaluation of Catechin from catechu and analysis by HPLC	6
3	Extraction, isolation and evaluation of Ellagic acid from Myrobalan	6
4	Separation of Clove oil ; isolation and evaluation of Eugenol by GC	6
5	Extraction and separation of Strychnine and Brucine from Nux vomica by Column Chromatography	9
6	Extraction and isolation of Forskolin/Ursolic acid	6
7	Determination of total anthraquinone from Aloes or senna/total flavanoid in citrus rind by UV spectrophotometer	6
8	Identification of any one phytoconstituent by UV, IR, NMR and MS data - case study	6
9	Evaluation of Analgesic activity of Berberine / Eugenol using hot-plate/tail flick/Writhing method.	6
10	Evaluation of antioxidant activity of Catechin/Ellagic acid /Eugenol using DPPH method	6
11	Antimicrobial activity of Eugenol/ Thymol/ Ellagicacid,/Catechin using broth dilution /agar plate method.	9
12	Smooth muscle relaxant property of Forskoline using Chicken ileum.	6

13	Skeletal muscle relaxant property/ locomotor activity of Diazepam/ any other synthetic/ herbal muscle relaxants (eg. Mint oil)	6
14	Lipase inhibition activity of forskolin/ catechin.	6
List of Text Books/ Reference Books		
1		
2		
3		
4		
5		
Course Outcomes (students will be able to…..)		
1		
2		
3		
4		

ELECTIVES

	Course Code: PHT 2001	Course Title: Biopharmaceutics and Pharmacokinetics	Credits = 3		
			L	T	P
	Semester:	Total contact hours: 45	2	1	0
List of Prerequisite Courses					
	Biopharmaceutics and Pharmacokinetics (B. Pharm) or equivalent				
List of Courses where this course will be prerequisite					
Description of relevance of this course in the M. Pharm Program					
To train students with reference to Biopharmaceutics and Pharmacokinetics					

Sr. No.	Course Contents (Topics and subtopics)	Reqd. hours	
		L	T
	Biopharmaceutics		
1	**Introduction: Recap of ADME, bioavailability, bioequivalence and factors affecting the same**	1	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 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	9	4
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	1
4	**Pharmacogenomics** ▪ Genetic basis of variation of pharmacokinetics ▪ Methods for pharmacogenomic profiling & study	2	1
	Pharmacokinetic		
1	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	2
2	Role of Pharmacokinetics in drug discovery; drug development and process		

	development;		
3	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	4
4	In-vitro-In-vivo correlation	2	1
5	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	1
List of Text Books/ Reference Books			
1	Biopharmaceutics and Clinical Pharmacokinetics by, Milo Gibaldi		
2	Biopharmaceutics and Pharmacokinetics; By Robert F Notari		
3	Applied biopharmaceutics and pharmacokinetics, Leon Shargel and Andrew B.C.YU 4th edition,Prentice-Hall Inernationaledition.USA		
4	Bio pharmaceutics and Pharmacokinetics-A Treatise, By D. M. Brahmankar and Sunil B.Jaiswal,VallabhPrakashanPitampura, Delhi		
5	Hand Book of Clinical Pharmacokinetics, By Milo Gibaldi and Laurie Prescott by ADIS Health Science Press.		
6	Biopharmaceutics and Clinical Pharmacokinetics-An introduction 4th edition Revised and expanded by Rebort F Notari Marcel Dekker Inn, New York and Basel, 1987.		
Course Outcomes (students will be able to…..)			
1	Understand the basic concepts in biopharmaceutics and pharmacokinetics andtheir significance		
2	Use of plasma drug concentration-time data to calculate the pharmacokineticparameters to describe the kinetics of drug absorption, distribution,metabolism, excretion, elimination		
3	To understand the concepts of bioavailability and bioequivalence of drugproducts and their significance		
4	Understand various pharmacokinetic parameters, their significance &applications.		
5	In-vitro-In-vivo correlation		

	Course Code: PHT 2002	Course Title: Intellectual property Rights and Patent Filing	Credits = 3		
			L	T	P
	Semester:	Total contact hours: 45	2	1	0
List of Prerequisite Courses					
	B. Pharm (Pharmaceutics) of ICT or equivalent				
List of Courses where this course will be prerequisite					
Description of relevance of this course in the M. Pharm / M. Tech Program					
To train the students on IPR					

Sr. No.	Course Contents (Topics and subtopics)	Reqd. hours	
		L (30)	T (15)
1	Introduction to IP	2	0
2	Copyright, Related Rights, Trademarks, Geographical Indications, Industrial Design	5	3
3	Patents	15	8
4	WIPO Treaties	2	1
5	Unfair Competition	2	1
6	Protection of New Varieties of Plants	2	1
7	Summary and Discussion on IP Rights	2	1

List of Text Books/ Reference Books		
1	Intellectual Property Rights – Basic concepts by M.M.S Karki	
2	Law Relating to Intellectual Property Rights (Fourth Edition, 2015) – by Dr. M.K.Bhandari	
Course Outcomes (students will be able to…..)		
1	Understand the Pharmaceutical legislations and their implications in the development and marketing of pharmaceuticals	
2	Understand copyright, trademarks and industrial design	
3	Understand basics of patent, filing process etc.	
4	Understand IR rights	

	Course Code: PHT 2003	Course Title: Advanced Biochemistry	Credits = 3		
			L	T	P
	Semester:	Total contact hours: 45	2	1	0
List of Prerequisite Courses					
List of Courses where this course will be prerequisite					
Description of relevance of this course in the M. Pharm / M. Tech. Program					

Sr. No.	Course Contents (Topics and subtopics)	Reqd. hours
1	Proteins: Structures – primary, secondary, tertiary, motifs, structural and functional domains, protein families and macromolecular assemblies.	4+2
2	Mechanisms for regulating protein function: Protein-protein interactions, interaction with ligands, Ca^{+2} and GTP as modulators, cyclic phosphorylation and dephosphorylation, proteolytic cleavage	4+2
3	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+2
4	Protein biosynthesis:Translation machinery in prokaryotic and eukaryotic systems, comparison of similarities and differences.	4+2
5	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+3
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+2
7	Lipids: Classification, nomenclature, stereochemistry, storage lipids, membrane lipids, lipids as second messengers and cofactors, biological role of lipids	4+2

List of Text Books/ Reference Books	
1	Lehninger Principles of Biochemistry, Lehninger and Nelson D. L.; Biochemistry, Stryer L.; Molecular Cell Biology, Lodish H. and Darneu J.
2	
3	

Course Outcomes (students will be able to…..)	
1	Understand protein structures and motifs
2	Biochemistry of proteins, lipids and carbohydrates
3	Purification of proteins including latest developments
4	Understand basics of nucleic acids

	Course Code: PHT 2004	Course Title: Drug Metabolism	Credits = 3		
			L	T	P
	Semester:	Total contact hours: 45	2	1	0
List of Prerequisite Courses					
List of Courses where this course will be prerequisite					
Description of relevance of this course in the M. Pharm / M. Tech. Program					

Sr. No.	Course Contents (Topics and subtopics)	Reqd. hours
1	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
2	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
3	Introduction to other drug metabolism enzyme isoforms/families Glucuronosyltransferases, glutathionetransferases, sulfotransferases, N-acetyltransferases, FMO's.	10
4	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

List of Text Books/ Reference Books	
1	Foye's Principles of Medicinal Chemistry, William D.A and Lemke T.L., 5th Edition; Handbook of Drug Metabolism, Woolf T.F.;
2	Drug Metabolising Enzymes, Lee J.S., Obach S.R., Fisher M.B.; Cassaret
3	Doull'sToxicilogy, The Basic Science of Poisons, Klaasen C. D., Amdur M.O., and Adull J.;
4	Fundamentals of Drug Metabolism and Disposition, La Du B.N., Mandel H.L., & Way L.E.
5	

Course Outcomes (students will be able to…..)	
1	
2	
3	
4	

	Course Code: PHT 2005	Course Title: Molecular Biology	Credits = 3		
			L	T	P
	Semester:	Total contact hours: 45	2	1	0
List of Prerequisite Courses					
List of Courses where this course will be prerequisite					
Description of relevance of this course in the M. Pharm / M. Tech. Program					

Sr. No.	Course Contents (Topics and subtopics)	Reqd. hours
1	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
2	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
3	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
4	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

List of Text Books/ Reference Books		
1	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.	
Course Outcomes (students will be able to…..)		
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	Course Code: PHT 2007	Course Title: Packaging Technology	Credits = 3		
			L	T	P
	Semester:	Total contact hours: 45	2	1	0
List of Prerequisite Courses					
	B. Pharm courses (Pharmaceutics) and B. Tech courses (Pharmaceutical Formulation Technology) of ICT or equivalent				
List of Courses where this course will be prerequisite					
Description of relevance of this course in the M. Pharm / M. Tech. Program					
To train the students on packaging and labeling of pharmaceutical products					

Sr. No.	Course Contents (Topics and subtopics)	Reqd. hours	
		L (30)	T (15)
1	Its status and scope in Pharmaceutical Industry	1	0
2	Classification of packaging material into primary and secondary packaging, functions of packaging.	2	1
3	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	2
4	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	3
5	Specifications, quality control tests and methods and evaluation of packaging of materials.	10	4
6	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	2
7	Sterilization of containers: Different methods of sterilization for containers (primary) including autoclaving, dry heat, gas sterilization, ionizing and non-ionizing radiations	1	1
8	Stability of packaging materials	2	1
9	Law and regulation governing packaging	1	1
List of Text Books/ Reference Books			
1	Pharmaceutical Packaging Technology – CRS press, Taylor and Francis group		

2	Pharmaceutical Packaging Handbook by Edward J. Bauer, CRS press, Taylor and Francis group	
Course Outcomes (students will be able to…..)		
1	Understand different types of packaging	
2	Understand primary and secondary packaging materials used	
3	Understand quality control tests, methods and evaluation of packaging of materials	
4	Understand labeling	
5	Understand different types of sterilization methods	

	Course Code: PHT 2012	**Course Title: Medicinal Natural Products**	**Credits = 3**		
			L	**T**	**P**
	Semester:	**Total contact hours: 45**	**2**	**1**	**0**
List of Prerequisite Courses					
List of Courses where this course will be prerequisite					
Description of relevance of this course in the M. Pharm / M. Tech. Program					

Sr. No.	**Course Contents (Topics and subtopics)**	**Reqd. hours**
1	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.	
List of Text Books/ Reference Books		
1	Medicinal Natural Products- A Biosynthetic Approach. Dewick P.M. 2nd edition/2002 John Wiley & Sons Ltd.	
2	Pharmacognosy & Phytochemistry Medicinal Plants. Bruneton J. 2nd edition/1999 Lavoisier Publishing Inc.	
3	Phytochemical Methods- A Guide to modern techniques of Plant analysis. Harborne J.B. 3rd edition/1998 Springer	
4	Natural Products- A Laboratory Guide Ikan R.2nd edition/1994 Academic Press	
5	Pharmacognosy. Tyler V.E. 8th edition/1981 Lea &Febiger	
6	Textbook of Pharmacognosy. Trease& Evans, 15th edition/2002 Harcourt Publishers	
7	Textbook of Pharmacognosy. Wallis 5th edition/1967 J. & A. Churchill Ltd.	
8	Plant Drug Analysis- A Thin Layer Chromatography Atlas Wagner H. 1984 Springer-Verlag	
9	Wealth of India (11 volumes) Publications and Information Directorate, CSIR 1992	
10	Atlas of Microscopy of Medicinal Plants, Culinary Herbs and Spices Jackson B.P. CBS	

	Publishers	
11	The Merck Index Merck Research Laboratories 13th edition, 2001 Merck & Co., Inc	
Course Outcomes (students will be able to…..)		
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	Course Code: PHT 2014	**Course Title: Chiral Synthesis**	**Credits = 3**		
			L	**T**	**P**
	Semester:	**Total contact hours: 45**	**2**	**1**	**0**
List of Prerequisite Courses					
List of Courses where this course will be prerequisite					
Description of relevance of this course in the M. Pharm / M. Tech. Program					

Sr. No.	**Course Contents (Topics and subtopics)**	**Reqd. hours**
1	Introduction, concept and importance of chirality Resolution of racemic mixtures Stereoselective and stereospecific synthesis Classification of types of reactions involved in chiral synthesis 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.	
List of Text Books/ Reference Books		
1	Chirality in Industry Vol –I, II and III , R. A. Sheldon,	
2	Chiral catalysis, Noyori, Asymmetric Catalysis vol I, II & III , Noyori.	
Course Outcomes (students will be able to…..)		
1	Importance of chirality and overview	
2	Non biological resolutions- resolution of racemates by distereoisomeric salt formation	
3	Asymmetric synthesis by chemical methods	
4	Overview of immobilization techniques and membrane reactors	
5	Understanding regulatory aspects of chiral drugs	

	Course Code: PHT 2016	Course Title: Quality Assurance and Validation	Credits = 3		
			L	T	P
	Semester:	Total contact hours: 45	2	1	0
List of Prerequisite Courses					
	B. Pharm courses (Pharmaceutics) of ICT or equivalent				
List of Courses where this course will be prerequisite					
Description of relevance of this course in the M. Pharm / M. Tech. Program					
To train the students on GLP, GMP and validation of pharmaceuticals					

Sr. No.	Course Contents (Topics and subtopics)	Reqd. hours	
		L (30)	T (15)
1	CGMP – Status and regulations,	2	1
2	GLP	1	0
3	Validation: Process validation for sterile and non-sterile formulations	9	4
4	Validation of Pharmaceutical water systems, validation of utilities, validation of environmental control systems	5	3
5	Systems validation and quality audits	5	3
6	Documentation	8	4

List of Text Books/ Reference Books	
1	Beotra's Law of Drugs Medicins and Cosmetics K. K. Singh, L. R. Bugga for the Law Book Co. Pvt. Ltd. Allahabad
2	Modern Pharmaceutics, G. S. Banker, New York, Marcel Dekker 1990
3	Fundamentals of Pharmacy, Blome H. E., Philadelphia, Fea and Febiger, 1985
4	Pharmaceutical Production Facilities: Design and Applications, G. C. Cole, New York Ellis Horwood 1990
5	Microbial Quality Assurance in Pharmaceuticals Cosmetics and Toiletries, S. F. Bloomfield, Chichester, Ellis, Horwood, 1998.
6	Encyclopedia of Pharmaceutical Technology, J. Swarbrick, New York, Marcel Dekker, 1993
7	Remington's Pharmaceutical Sciences, A. R. Gennaro Mac Pub. Co. Easton, Pennsylvania 1990
8	Indian Pahrmacopoiea, British Pahrmcopoiea, United States Pharmcopoiea.
9	Good Laboratory Practice Regulations A. F. Hirsch, New York, Marcel Dekker, 1989
10	Good Laboratory Practice Regulations Weinberg New York, Marcel Dekker, 1995.

Course Outcomes (students will be able to…..)	
1	Understand basics of quality assurance
2	Understand validation and documentation

	Course Code: PHT 2023	Course Title: Technological of Fine and Speciality Chemicals	Credits = 3		
			L	T	P
	Semester:	Total contact hours: 45	2	1	0
List of Prerequisite Courses					
	Catalysis and catalytic processes				
List of Courses where this course will be prerequisite					
Description of relevance of this course in the M. Tech. Program					
Study of Chemical technology of selected Fine chemicals and Speciality chemicals					

Sr. No	Course Contents (Topics and subtopics)	Reqd. hours
1	**Introduction**. Characteristic features of fine and speciality chemicals manufacture.Types of Catalysts in Fine Chemicals Synthesis**.** Role of Heterogeneous Catalyst in Improving Selectivity**.** Aspects of Process Development of Fine Chemicals**.** Relevant Separation Methods**.** Different Types of Manufacturing Facilities of Fine Chemicals	4+3
2	**Chemistry of Fine and Speciality Chemicals Synthesis**. What are fine and speciality chemicals? Historical development of organic synthesis. Fine and speciality chemicals vs. bulk chemicals manufacture. Process selection: process profile analysis. Factors influencing process choice: cleaner and safer technologies. E factors and atom utilization. The role of catalysis in waste minimization. Fine chemicals and speciality chemicals and catalysis: examples.	6+2
3	**Types of Catalysts in Fine Chemicals and speciality Synthesis**. Introduction. Mechanism of catalysis. Heterogeneous catalysts - types and preparation. Catalyst performance: activity, selectivity, and stability. Catalyst selection. Catalyst characterization. Homogeneous catalysis. Phase-transfer catalysis. Biocatalysis.	6+2
4	**Role of Heterogeneous Catalyst in Improving Selectivity.**Heterogenization of homogeneous catalysis. Additional liquid phase. Rate and selectivity improvement via manipulation of 'microenvironment'. Rate and selectivity improvement via manipulation of 'macroenvironment'. Unconventional techniques. Continuous processes.	4+3
5	**Aspects of Process Development of Fine and speciality Chemicals**. Introduction. Steps in process development. Scale-up procedures. Chemical reactor scale-up, design, and operation. Acronyms and symbols.	5+2
6	**Brief overview of Relevant Separation Methods**. Distillation. Extraction. Crystallization. Adsorption. Membrane separations. **Brief overview of Different Types of Manufacturing Facilities of Fine and speciality Chemicals**. Types of production plants. Typical equipment in a multi-product plant. Production costs. Design and scheduling of batch plants. Principles of good manufacturing practice.	5+3

List of Text Books/ Reference Books		
1	Fine Chemicals Manufacture: Technology and Engineering, A. Cybulski M.M. Sharma R.A. Sheldon J.A. Moulijn	
2	Sustainable Value Creation in the Fine and Specialty Chemicals Industry – R Rajagopal	
3	Specialty Chemicals Innovations in industrial synthesis and applications - B Perason	
Course Outcomes (students will be able to…..)		
1	Grasp the manufacturing of various Fine chemicals and speciality chemicals	
2	understand the process flow diagram and various process parameters	
3	Identify and solve engineering problems during production	

	Course Code: PHT 2305	Course Title: Clinical Research Management	Credits = 3		
			L	T	P
	Semester: II	Total contact hours: 45	2	1	0
List of Prerequisite Courses					
	Anatomy, Physiology and Pathology-I, II, Pharmacology I to IV and Clinical Pharmacy and drug interactions of ICT B Pharm syllabus or any equivalent course.				
List of Courses where this course will be prerequisite					
	Clinical trials, regulatory affairs				
Description of relevance of this course in the M. Pharm / M. Tech. Program					

Sr. No	Course Contents (Topics and subtopics)	Reqd. hours	
		L(30)	T(15)
1	Brief Introduction to Clinical Research I. What is Clinical Research? Why Clinical Research? II. Sectors of Clinical Research III. Types of clinical trials IV. Regulatory guidelines V. Ethics VI. Management of Clinical research	1	0
2	Scientific & Technical aspects of Clinical Research I. Development of Investigational product/drug for human administration—Phase I, II, III and IV trials II. Technical requirements	2	1
3	Regulatory Requirements of Clinical Research I. Regulatory guidelines--- Schedule Y, US FDA, EU guidelines to be discussed in detail II. Brief outline of ICH-GCP	4	2
4	ETHICS in Clinical Research I. Ethics to be followed during the conduct of different phases of Clinical Trials II. Importance of Ethical conduct of clinical Trials III. Ethics Committee --- role, responsibilities and function IV. Regulatory expectations from ethics committee	5	2
5	Procedural and Practical Clinical Research I. SOPs to be discussed in detail II. Practical implementation of SOPs	4	2
6	Management of Clinical Research I. Sponsor & Investigator – CRO/ NGO II. Patients / Volunteers recruitment III. Medical and technical teams IV. Pharmacy and responsibilities of pharmacists V. Vendors VI. Medical management VII. Logistics	7	4
7	Quality control and Quality Assurance in Clinical Trials I. Monitoring of clinical trials	2	1
8	Data Management and Statistics	3	2
9	Pharmacovigillance I. Adverse event reporting	2	1

List of Text Books/ Reference Books		
1	Clinical Pharmacy and therapeutics by Roger Walker.	
2	Clinical pharmacy practice by MilapNahata.	
Course Outcomes (students will be able to…..)		
1	Understand theoretically the current scenario of Clinical Research	
2	Understand the scope of clinical research including clinical trials, regulatory requirements, ethics, management, quality control and quality assurance of Clinical research.	
3	Develop skills in different fields and aspects of clinical research	
4	Additional qualification as a prerequisite to be employed in the clinical research Industry worth $64 billion	

	Course Code: PHT 2011	**Course Title: Advances in Receptor Pharmacology**	**Credits = 3**		
			L	**T**	**P**
	Semester:	**Total contact hours: 45**	**2**	**1**	**0**
List of Prerequisite Courses					
List of Courses where this course will be prerequisite					
Description of relevance of this course in the M. Pharm / M. Tech. Program					

Sr. No.	**Course Contents (Topics and subtopics)**	**Reqd. hours**
1	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	
2		
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5		
List of Text Books/ Reference Books		
1	Pharmacology 3rd edition –H. P. Rang and M. M. Dale	
2	Textbook of receptor Pharmacology by John C. Foreman, TorbenJohasen	
3	Drug receptors and their effectors edited by Niel J. M. Birdsall	
4	Drug receptors by H. P. Raug	
5		

Course Outcomes (students will be able to…..)		
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	Course Code: PYT 2106	**Course Title: Physical Methods of Analysis**	**Credits = 3**		
			L	**T**	**P**
	Semester:	**Total contact hours: 45**	**2**	**1**	**0**
List of Prerequisite Courses					
List of Courses where this course will be prerequisite					
Description of relevance of this course in the M. Pharm /M. Tech. Program					

Sr. No.	**Course Contents (Topics and subtopics)**	**Reqd. hours**
1	**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.	
2	**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.	
3	**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.	
4	**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.	
5	**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).	
6	**Chromatography:** Basic theory of separation, efficiency, resolution; Liquid chromatography, high performances liquid chromatography; Gas chromatography-columns and detectors; Qualitative and quantitative analysis.	
7	**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.	
List of Text Books/ Reference Books		

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Course Outcomes (students will be able to…..)		
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	Course Code: PHT 2022	**Course Title: Active Pharmaceutical Ingredients Technology**	**Credits = 3**		
			L	**T**	**P**
	Semester:	**Total contact hours: 45**	**2**	**1**	**0**
List of Prerequisite Courses					
	Process technology of Drug and intermediates				
List of Courses where this course will be prerequisite					
Description of relevance of this course in the M. Tech. Program					
Study of Chemical technology of selected APIs including Chiral APIs. Importance of GMP, QA, RA and safety in API industry					
Sr. No.	**Course Contents (Topics and subtopics)**		**Reqd. hours**		
1	Current status of pharmaceutical industry: Status of bulk drugs, natural products and formulations in India vis-a-vis industrialized nations. Import and Export of APIs		2+1		
2	Scale-up Techniques: for process research and development, optimization, maximization of productivity, in-process control techniques.		2+1		
3	Chemical technology of selected APIs : Case studies with emphasis on rationale for selection of routes, raw materials, process control methods, pollution control procedures, polymorphs, safety etc.		7+3		
4	Chemical technology of Chiral APIs: Case studies with emphasis on rationale for selection of routes, raw materials, process control methods, pollution control procedures, polymorphs, safety etc.		7+3		
5	Impurity consideration: Introduction, Steps to optimizing reactions, minimizing impurity formation by indentifying impurities first, method development for separation, synthesis and isolation of impurities and their characterization		4+3		
6	Overview of plant layout, plant design, utilities and process flow sheets		2+1		
7	Raw material consumption and Costing		2+1		
8	Overview of GMP and Safety in API industry		2+1		
9	Overview of Quality Assurance and Regulatory Affairs		2+1		
List of Text Books/ Reference Books					
1	Process Chemistry in Pharmaceutical Industry by Kumar Gadamasetti, Vol I & II				
2	Advanced Organic Chemistry by Jerry March				
3	Pharmaceutical Process Chemistry for Synthesis: Rethinking the Routes to Scale-Up by Peter J. Harrington , Wiley				

4	Practical Process Research and Development by Neal G. Anderson, Academic Press	
5	Strategies for Organic Drug Synthesis and Design by Daniel Lednicer	
Course Outcomes (students will be able to…..)		
1	Grasp the manufacturing of various APIs	
2	Understand the process flow diagram and various process parameters	
3	Identify and solve engineering problems during production	
4	Appreciate the importance of GMP,QA and RA departments in API industry	