MANIPAL
ACADEMY of HIGHER EDUCATION
(Deemed to be University under Section 3 of the UGC Act, 1956)

Academic Program Regulations – 2017

Based on PCI Notification in the Gazette of India, No 362, dated 11 December, 2014

Program Title: MPharm (Master of Pharmacy)

CBCS (Choice Based Credit System)

Specialization: Pharmacognosy

Manipal College of Pharmaceutical Sciences
Manipal Academy of Higher Education
Manipal-576 104, Karnataka, India

MANIPAL
ACADEMY of HIGHER EDUCATION
(Institution of Eminence Deemed to be University)

July 1, 2023

Academic Program Regulations – 2017 : MPharm, CBCS – Approval

The Master of Pharmacy (MPharm) program, CBCS of Manipal Academy of Higher Education being offered at Manipal College of Pharmaceutical Sciences under the title "Academic Program Regulations – 2017: MPharm, CBCS" has been duly approved by the Academic Council of Manipal Academy of Higher Education.

REGISTRAR

MANIPAL ACADEMY OF HIGHER EDUCATION * INSTITUTION OF EMINENCE DEEMED TO BE UNIVERSITY * MANIPAL - 576 104 *

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PHARMACY COUNCIL OF INDIA

NOTIFICATION

New Delhi, the 10th December, 2014

The Master of Pharmacy (M.Pharm) Course Regulations, 2014

No. 14-136/ 2014-PCI.—In exercise of the powers conferred by Sections 10 and 18 of the Pharmacy Act, 1948 (8 of 1948), the Pharmacy Council of India, with the approval of the Central Government hereby makes the following regulations; namely–

CHAPTER I: REGULATIONS

1. Short title and commencement

These regulations shall be called as "Master of Pharmacy (MPharm) Degree Program-Regulations - Choice Based Credit System (CBCS). The program regulations are based on the PCI notification in the Gazette of India, No. 362, dated 11 December 2014.

They shall come into effect from the academic year 2017-18. The regulations framed are subject to modifications from time to time by the authorities of the Manipal Academy of Higher Education.

2. Minimum qualification for admission

A pass in the following examinations

a) BPharm degree examination of an Indian university established by law in India from an institution approved by Pharmacy Council of India and has scored not less than 55% of the maximum marks (aggregate of 4 years of BPharm).
b) Every student, selected for admission to postgraduate pharmacy program in any PCI approved institution should have obtained registration with the State Pharmacy Council or should obtain the same within one month from the date of his/her admission, failing which the admission of the candidate shall be cancelled.
c) Any foreign pharmacy degree approved by the Pharmacy Council of India.

Note: It is mandatory to submit a migration certificate obtained from the respective university where the candidate had passed his/her qualifying degree (BPharm)

3. Duration of the program

The program of study for MPharm shall extend over a period of four semesters (two academic years). The curricula and syllabi for the program shall be prescribed from time to time by Manipal Academy of Higher Education based on the inputs from Pharmacy Council of India, New Delhi.

4. Medium of instruction and examination

Medium of instruction and examination shall be in English.

5. Working days in each semester

Each semester shall consist of not less than 100 working days. The odd semesters shall be conducted from the month of July/August to November/December and the even semesters shall be conducted for the month of December/January to May/June in an academic year.

6. Attendance and progress

A candidate is required to put in at least 80% attendance in individual courses considering the theory and practical separately. The candidate shall complete the prescribed course satisfactorily to be eligible to appear for the respective examinations.

7. Program/Course credit structure

As per the philosophy of Credit Based Semester System, certain quantum of academic work viz. theory classes, practical classes, seminars etc., are measured in terms of credits. On satisfactory completion of the courses, a candidate earns credits. The amount of credit associated with a course is dependent upon the number of hours of instruction per week in that course. Similarly, the credit associated with any of the other academic, co-curricular activities is dependent upon the quantum of work expected to be put in for each of these activities per week/per activity.

7.1. Credit assignment

7.1.1. Theory and laboratory courses

Courses are broadly classified as Theory and Practical. Theory courses consist of Lecture (L) and tutorial (T). Practical (P) courses consist of hours spent in the laboratory. Credits (C) for a course are dependent on the number of hours of instruction per week in that course, and is obtained by using a multiplier of one (1) for lecture/tutorial and a multiplier of half (½) for practical (laboratory) hours. Thus, for example, a theory course, having four lectures per week throughout the semester carries a credit of 4. Similarly, a practical having four laboratory hours per week throughout the semester carries a credit of 2. The contact hours of seminars, and research work and journal club shall be treated as that of practical courses for the purpose of calculating credits, i.e., the contact hours shall be multiplied by ½.

7.2. Minimum credit requirements

The minimum credit points required for the award of MPharm degree is 95. However, based on the credit points earned by the students under the heads of co-curricular activities and choice based inter/multidisciplinary courses, a student shall earn a maximum of 100 credit points. These credits are divided into theory courses, practical, seminars, research work, journal club and co-curricular activities over the duration of four semesters. The credits are distributed semester-wise as shown in Table 14. Courses generally progress in sequence, building competencies and their positioning indicate certain academic maturity on the part of the learners. Learners are expected to follow the semester-wise schedule of courses given in the syllabus.

8. Academic work

A regular record of attendance both in theory, practical, seminar, assignment, journal club, discussion with the supervisor, research work presentation and dissertation shall be maintained by the department/teaching staff of the respective courses.

9. Course work of study

The specializations in MPharm program are given in Table 1.

Table 1. List of MPharm specializations and their codes

S. No.	Specialization	Code
1	Pharmaceutics	MPH
2	Industrial Pharmacy	MIP
3	Pharmaceutical Chemistry	MPC
4	Pharmaceutical Analysis	MPA
5	Pharmaceutical Quality Assurance	MQA
6	Pharmaceutical Regulatory Affairs	MRA
7	Pharmaceutical Biotechnology	MPB
8	Pharmacy Practice	MPP
9	Pharmacology	MPL
10	Pharmacognosy	MPG

The course work of MPharm specializations shall include semester wise theory and practical as given in Table 2 to 13. The number of hours to be devoted to each theory lectures (L), tutorials (T) and practical (P) course in any semester shall not be less than that shown in Table 2 to 13.

Table 2. Course work of MPharm – Pharmaceutics (MPH) specialization						
Course Code	**Course Title**	**Credit hours/week**			**Credit Points**	**Marks**
		Lecture (L)	**Tutorial (T)**	**Practical (P)**		
Semester I						
PQA-MPH101T	Modern Pharmaceutical Analytical Techniques	4	--	--	4	100
PCE-MPH102T	Drug Delivery Systems	4	1	--	5	100
PCE-MPH103T	Modern Pharmaceutics	4	1	--	5	100
PRM-MPH104T	Regulatory Affairs	4	1	--	5	100
PCE-MPH105P	Pharmaceutics Practical I	--	--	12	6	150
PCE-MPH106S	Seminar*	--	--	2	1	100
	Total	**16**	**3**	**14**	**26**	**650**
Semester II						
PCE-MPH201T	Molecular Pharmaceutics (Nano Tech and Targeted DDS)	4	1	--	5	100
PCE-MPH202T	Advanced Biopharmaceutics and Pharmacokinetics	4	1	--	5	100
PCE-MPH203T	Computer Aided Drug Delivery Systems	4	1	--	5	100
PCE-MPH204T	Cosmetic and Cosmeceuticals	4	1	--	5	100
PCE-MPH205P	Pharmaceutics Practical II	--	--	12	6	150
PCE-MPH206S	Seminar*	--	--	2	1	100
	Total	**16**	**4**	**14**	**27**	**650**
* No end-semester examination. Only continuous mode						

Table 3. Course work of MPharm –Industrial Pharmacy (MIP) specialization						
Course Code	**Course Title**	**Credit hours/week**			**Credit Points**	**Marks**
		Lecture (L)	**Tutorial (T)**	**Practical (P)**		
Semester I						
PQA-MIP101T	Modern Pharmaceutical Analytical Techniques	4	--	--	4	100
PCE-MIP102T	Pharmaceutical Formulation Development	4	1	--	5	100
PCE-MIP103T	Novel Drug Delivery Systems	4	1	--	5	100
PRM-MIP104T	Intellectual Property Rights	4	1	--	5	100
PCE-MIP105P	Industrial Pharmacy Practical I	--	--	12	6	150
PCE-MIP106S	Seminar*	--	--	2	1	100
	Total	**16**	**3**	**14**	**26**	**650**
Semester II						
PCE-MIP201T	Advanced Biopharmaceutics and Pharmacokinetics	4	1	--	5	100
PCE-MIP202T	Scale-up and Technology Transfer	4	1	--	5	100
PCE-MIP203T	Pharmaceutical Production Technology	4	1	--	5	100
PRM-MIP204T	Entrepreneurship Management	4	1	--	5	100
PCE-MIP205P	Industrial Pharmacy Practical II	--	--	12	6	150
PCE-MIP206S	Seminar*	--	--	2	1	100
	Total	**16**	**4**	**14**	**27**	**650**
* No end-semester examination. Only continuous mode.						

Table 4. Course work of MPharm – Pharmaceutical Chemistry (MPC) specialization						
Course Code	**Course Title**	**Credit hours/week**			**Credit Points**	**Marks**
		Lecture (L)	**Tutorial (T)**	**Practical (P)**		
Semester I						
PQA-MPC101T	Modern Pharmaceutical Analytical Techniques	4	--	--	4	100
PCH-MPC102T	Advanced Organic Chemistry I	4	1	--	5	100
PCH-MPC103T	Advanced Medicinal Chemistry	4	1	--	5	100
PCH-MPC104T	Chemistry of Natural Products	4	1	--	5	100
PCH-MPC105P	Pharmaceutical Chemistry Practical I	--	--	12	6	150
PCH-MPC106S	Seminar*	--	--	2	1	100
	Total	**16**	**3**	**14**	**26**	**650**
Semester II						
PCH-MPC201T	Advanced Spectral Analysis	4	1	--	5	100
PCH-MPC202T	Advanced Organic Chemistry II	4	1	--	5	100
PCH-MPC203T	Computer Aided Drug Design	4	1	--	5	100
PCH-MPC204T	Pharmaceutical Process Chemistry	4	1	--	5	100
PCH-MPC205P	Pharmaceutical Chemistry Practical II	--	--	12	6	150
PCH-MPC206S	Seminar*	--	--	2	1	100
	Total	**16**	**4**	**14**	**27**	**650**
* No end-semester examination. Only continuous mode.						

Table 5. Course work of MPharm – Pharmaceutical Analysis (MPA) specialization						
Course Code	**Course Title**	**Credit hours/week**			**Credit Points**	**Marks**
		Lecture (L)	**Tutorial (T)**	**Practical (P)**		
Semester I						
PQA-MPA101T	Modern Pharmaceutical Analytical Techniques	4	--	--	4	100
PCH-MPA102T	Advanced Pharmaceutical Analysis	4	1	--	5	100
PCH-MPA103T	Pharmaceutical Validation	4	1	--	5	100
PCH-MPA104T	Food Analysis	4	1	--	5	100
PCH-MPA105P	Pharmaceutical Analysis Practical I	--	--	12	6	150
PCH-MPA106S	Seminar*	--	--	2	1	100
	Total	**16**	**3**	**14**	**26**	**650**
Semester II						
PCH-MPA201T	Advanced Instrumental Analysis	4	1	--	5	100
PCH-MPA202T	Modern Bioanalytical Techniques	4	1	--	5	100
PCH-MPA203T	Quality Control and Quality Assurance	4	1	--	5	100
PCH-MPA204T	Herbal and Cosmetic Analysis	4	1	--	5	100
PCH-MPA205P	Pharmaceutical Analysis Practical II	--	--	12	6	150
PCH-MPA206S	Seminar*	--	--	2	1	100
	Total	**16**	**4**	**14**	**27**	**650**
* No end-semester examination. Only continuous mode.						

Table 6. Course work of MPharm – Pharmaceutical Quality Assurance (MQA) specialization						
Course Code	**Course Title**	**Credit hours/week**			**Credit Points**	**Marks**
		Lecture (L)	**Tutorial (T)**	**Practical (P)**		
Semester I						
PQA-MQA101T	Modern Pharmaceutical Analytical Techniques	4	--	--	4	100
PQA-MQA102T	Quality Management Systems	4	1	--	5	100
PQA-MQA103T	Quality Control and Quality Assurance	4	1	--	5	100
PQA-MQA104T	Product Development and Technology Transfer	4	1	--	5	100
PQA-MQA105P	Pharmaceutical Quality Assurance Practical I	--	--	12	6	150
PQA-MQA106S	Seminar*	--	--	2	1	100
	Total	**16**	**3**	**14**	**26**	**650**
Semester II						
PQA-MQA201T	Hazards and Safety Management	4	1	--	5	100
PQA-MQA202T	Pharmaceutical Validation	4	1	--	5	100
PQA-MQA203T	Audits and Regulatory Compliance	4	1	--	5	100
PQA-MQA204T	Pharmaceutical Manufacturing Technology	4	1	--	5	100
PQA-MQA205P	Pharmaceutical Quality Assurance Practical II	--	--	12	6	150
PQA-MQA206S	Seminar*	--	--	2	1	100
	Total	**16**	**4**	**14**	**27**	**650**
* No end-semester examination. Only continuous mode.						

Table 7. Course work of MPharm – Pharmaceutical Regulatory Affairs (MRA) specialization						
Course Code	**Course Title**	**Credit hours/week**			**Credit Points**	**Marks**
		Lecture (L)	**Tutorial (T)**	**Practical (P)**		
Semester I						
PRM-MRA101T	Good Regulatory Practices	4	--	--	4	100
PRM-MRA102T	Documentation and Regulatory Writing	4	1	--	5	100
PRM-MRA103T	Clinical Research Regulations	4	1	--	5	100
PRM-MRA104T	Regulations and Legislation for Drugs & Cosmetics, Medical Devices, Biologicals & Herbals and Food & Nutraceuticals in India and Intellectual Property Rights	4	1	--	5	100
PRM-MRA105P	Regulatory Affairs Practical I	--	--	12	6	150
PRM-MRA106S	Seminar*	--	--	2	1	100
	Total	**16**	**3**	**14**	**26**	**650**
Semester II						
PRM-MRA201T	Regulatory Aspects of Drugs and Cosmetics	4	1	--	5	100
PRM-MRA202T	Regulatory Aspects of Herbal and Biologicals	4	1	--	5	100
PRM-MRA203T	Regulatory Aspects of Medical Devices	4	1	--	5	100
PRM-MRA204T	Regulatory Aspects of Food and Nutraceuticals	4	1	--	5	100
PRM-MRA205P	Regulatory Affairs Practical II	--	--	12	6	150
PRM-MRA206S	Seminar*	--	--	2	1	100
	Total	**16**	**4**	**14**	**27**	**650**
* No end-semester examination. Only continuous mode.						

Table 8. Course work of MPharm – Pharmaceutical Biotechnology (MPB) specialization						
Course Code	**Course Title**	**Credit hours/week**			**Credit Points**	**Marks**
		Lecture (L)	**Tutorial (T)**	**Practical (P)**		
Semester I						
PQA-MPB101T	Modern Pharmaceutical Analytical Techniques	4	--	--	4	100
PBT-MPB102T	Microbial and Cellular Biology	4	1	--	5	100
PBT-MPB103T	Bioprocess Engineering and Technology	4	1	--	5	100
PBT-MPB104T	Advanced Pharmaceutical Biotechnology	4	1	--	5	100
PBT-MPB105P	Pharmaceutical Biotechnology Practical I	--	--	12	6	150
PBT-MPB106S	Seminar*	--	--	2	1	100
	Total	**16**	**3**	**14**	**26**	**650**
Semester II						
PBT-MPB201T	Proteins and Protein Formulations	4	1	--	5	100
PBT-MPB202T	Immunotechnology	4	1	--	5	100
PBT-MPB203T	Bioinformatics and Computational Biotechnology	4	1	--	5	100
PBT-MPB204T	Biological Evaluation of Drug Therapy	4	1	--	5	100
PBT-MPB205P	Pharmaceutical Biotechnology Practical II	--	--	12	6	150
PBT-MPB206S	Seminar*	--	--	2	1	100
	Total	**16**	**4**	**14**	**27**	**650**
* No end-semester examination. Only continuous mode.						

Table 9. Course work of MPharm – Pharmacy Practice (MPP) specialization						
Course Code	**Course Title**	**Credit hours/week**			**Credit Points**	**Marks**
		Lecture (L)	**Tutorial (T)**	**Practical (P)**		
Semester I						
PPR-MPP101T	Clinical Pharmacy Practice	4	--	--	4	100
PPR-MPP102T	Pharmacotherapeutics I	4	1	--	5	100
PPR-MPP103T	Hospital and Community Pharmacy	4	1	--	5	100
PPR-MPP104T	Clinical Research	4	1	--	5	100
PPR-MPP105P	Pharmacy Practice Practical I	--	--	12	6	150
PPR-MPP106S	Seminar*	--	--	2	1	100
	Total	**16**	**3**	**14**	**26**	**650**
Semester II						
PPR-MPP201T	Principles of Quality Use of Medicines	4	1	--	5	100
PPR-MPP202T	Pharmacotherapeutics II	4	1	--	5	100
PPR-MPP203T	Clinical Pharmacokinetics and Therapeutic Drug Monitoring	4	1	--	5	100
PPR-MPP204T	Pharmacoepidemiology and Pharmacoeconomics	4	1	--	5	100
PPR-MPP205P	Pharmacy Practice Practical II	--	--	12	6	150
PPR-MPP206S	Seminar*	--	--	2	1	100
	Total	**16**	**4**	**14**	**27**	**650**
* No end-semester examination. Only continuous mode.						

Table 10. Course work of MPharm – Pharmacology (MPL) specialization						
Course Code	**Course Title**	**Credit hours/week**			**Credit Points**	**Marks**
		Lecture (L)	**Tutorial (T)**	**Practical (P)**		
Semester I						
PQA-MPL101T	Modern Pharmaceutical Analytical Techniques	4	--	--	4	100
PHA-MPL102T	Advanced Pharmacology I	4	1	--	5	100
PHA-MPL103T	Pharmacological and Toxicological Screening Methods I	4	1	--	5	100
PHA-MPL104T	Cellular and Molecular Pharmacology	4	1	--	5	100
PHA-MPL105P	Pharmacology Practical I	--	--	12	6	150
PHA-MPL106S	Seminar*	--	--	2	1	100
	Total	**16**	**3**	**14**	**26**	**650**
Semester II						
PHA-MPL201T	Advanced Pharmacology II	4	1	--	5	100
PHA-MPL202T	Pharmacological and Toxicological Screening Methods II	4	1	--	5	100
PHA-MPL203T	Principles of Drug Discovery	4	1	--	5	100
PHA-MPL204T	Clinical Research and Pharmacovigilance	4	1	--	5	100
PHA-MPL205P	Pharmacology Practical II	--	--	12	6	150
PHA-MPL206S	Seminar*	--	--	2	1	100
	Total	**16**	**4**	**14**	**27**	**650**
* No end-semester examination. Only continuous mode.						

Table 11. Course work of MPharm – Pharmacognosy (MPG) specialization						
Course Code	**Course Title**	**Credit hours/week**			**Credit Points**	**Marks**
		Lecture (L)	**Tutorial (T)**	**Practical (P)**		
Semester I						
PQA-MPG101T	Modern Pharmaceutical Analytical Techniques	4	--	--	4	100
PCO-MPG102T	Advanced Pharmacognosy I	4	1	--	5	100
PCO-MPG103T	Phytochemistry	4	1	--	5	100
PCO-MPG104T	Industrial Pharmacognostical Technology	4	1	--	5	100
PCO-MPG105P	Pharmacognosy Practical I	--	--	12	6	150
PCO-MPG106S	Seminar*	--	--	2	1	100
	Total	**16**	**3**	**14**	**26**	**650**
Semester II						
PCO-MPG201T	Medicinal Plant Biotechnology	4	1	--	5	100
PCO-MPG202T	Advanced Pharmacognosy II	4	1	--	5	100
PCO-MPG203T	Indian Systems of Medicine	4	1	--	5	100
PCO-MPG204T	Herbal Cosmetics	4	1	--	5	100
PCO-MPG205P	Pharmacognosy Practical II	--	--	12	6	150
PCO-MPG206S	Seminar*	--	--	2	1	100
	Total	**16**	**4**	**14**	**27**	**650**
* No end-semester examination. Only continuous mode.						

Table 13. Course work for MPharm III and IV semesters (Common for all specializations)						
Course Code	**Course Title**	**Credit hours/week**			**Credit Points**	**Marks**
		Lecture (L)	**Tutorial (T)**	**Practical (P)**		
PHA-MRM301T	Research Methodology and Biostatistics*	**4**	**--**	**--**	**4**	**100**
MJC302P	Journal Club*	**--**	**--**	**2**	**1**	**100**
MRW401P	Research Work	**--**	**--**	**70**	**35**	**600**
	Total	**4**	**--**	**72**	**40**	**800**
***** No end-semester examination. Only continuous mode						

Table 14. Semester wise course work credits distribution	
Semester	**Credit Points**
I	26
II	27
III and IV	40
Total course work credits	93
Co-curricular activities (Attending conference, scientific presentations, other scholarly activities and choice based inter/multidisciplinary courses)	Minimum=02* Maximum=07*
Total credit points	**Minimum=95** **Maximum=100**

*Credit points for co-curricular activities (Table 15A) and choice based inter/multidisciplinary courses (Table 15B).

Table 15A. Guidelines for awarding credit points for co-curricular activities	
Name of the Activity	**Maximum Credit Points Eligible/ Activity**
Participation in National level seminar/Conference/Workshop/Symposium/Training programs (related to the specialization of the student)	01
Participation in International level seminar/Conference/Workshop/Symposium/Training programs (related to the specialization of the student)	02
Academic award/ Research award from State level/National agencies	01
Academic award/Research award from International agencies	02
Research/ Review publication in National journals (Indexed in Scopus/Web of Science)	01
Research/ Review publication in International journals (Indexed in Scopus/Web of Science)	02
Note: International conference: Held outside India International journal: The editorial board outside India *The credit points assigned for extracurricular and or co-curricular activities shall be given by the principal of the college and the same shall be submitted to the university. The criteria to acquire this credit point shall be defined by the college from time to time.	

Table 15B. List of choice based inter/multidisciplinary courses			
Course Code	**Course Title**	**Credits**	**Department/Institution offering the Course**
Interdisciplinary courses			
PCE-001E	Generic Drug Development	1	Pharmaceutics, MCOPS
PCE-002E	Pharmaceutical Dissolution Technology	1	Pharmaceutics, MCOPS
PCE-003E	Particulate Drug Delivery Systems	1	Pharmaceutics, MCOPS
PCE-004E	3D Printing in Pharmaceutical Manufacturing	1	Pharmaceutics, MCOPS
PCH-001E	Preparative Separation Techniques	1	Pharmaceutical Chemistry, MCOPS
PCH-002E	Molecular Modeling and Drug Design	1	Pharmaceutical Chemistry, MCOPS
PCH-003E	Hyphenated Techniques	1	Pharmaceutical Chemistry, MCOPS
PCH-004E	Chemicals - Environment, Health and Safety	1	Pharmaceutical Chemistry, MCOPS
PQA-001E	Theory and Practice of Analytical and Bioanalytical Method Development and Validation	1	Pharmaceutical Quality Assurance, MCOPS
PQA-002E	Good Documentation Practices and e-Documentation Practices in Pharmaceutical Industry	1	Pharmaceutical Quality Assurance, MCOPS
PQA-003E	Trouble Shooting in High Performance Liquid Chromatography	1	Pharmaceutical Quality Assurance, MCOPS
PQA-004E	Professional Development	1	Pharmaceutical Quality Assurance, MCOPS

PQA-005E	Stability Testing of Drugs and Biologicals	1	Pharmaceutical Quality Assurance, MCOPS
PQA-006E	USFDA Drug Regulatory Affairs	1	Pharmaceutical Quality Assurance, MCOPS
PQA-007E	Rest of the World Drug Regulations	1	Pharmaceutical Quality Assurance, MCOPS
PQA-008E	Evaluation of Medical Devices	1	Pharmaceutical Quality Assurance, MCOPS
PBT-001E	Clean Room Concepts	1	Pharmaceutical Biotechnology, MCOPS
PBT-002E	Biosimilars	1	Pharmaceutical Biotechnology, MCOPS
PBT-003E	Principles of Gene Cloning	1	Pharmaceutical Biotechnology, MCOPS
PBT-004E	Tissue Engineering	1	Pharmaceutical Biotechnology, MCOPS
PPR-001E	Retail Pharmacy Practice	1	Pharmacy Practice, MCOPS
PPR-002E	Fundamentals of Medical Writing	1	Pharmacy Practice, MCOPS
PPR-003E	Systematic Review and Meta-Analysis	1	Pharmacy Practice, MCOPS
PPR-004E	Pharmacokinetics Data Analysis (Employing WinNonlin)	1	Pharmacy Practice, MCOPS
PHA-001E	Cancer Biology	1	Pharmacology, MCOPS
PHA-002E	Screening Methods for Drug Development	1	Pharmacology, MCOPS
PHA-003E	Free Radical Biology and Medicine	1	Pharmacology, MCOPS
PHA-004E	Regulatory Toxicology in Drug Discovery and Development	1	Pharmacology, MCOPS
PCO-001E	Nutraceuticals	1	Pharmacognosy, MCOPS
PCO-002E	Extraction, Separation and Purification of Phytoconstituents	1	Pharmacognosy, MCOPS
PCO-003E	Nanophytopharmaceuticals	1	Pharmacognosy, MCOPS
PCO-004E	Herbal Monographs	1	Pharmacognosy, MCOPS
PRM-001E	Retail Business Management	1	Pharmaceutical Regulatory Affairs & Management, MCOPS
PRM-002E	Intellectual Property Management	1	Pharmaceutical Regulatory Affairs & Management, MCOPS
PRM -003E	General Management Principles	1	Pharmaceutical Regulatory Affairs & Management, MCOPS
PRM -004E	Entrepreneurship Development	1	Pharmaceutical Regulatory Affairs & Management, MCOPS
Multidisciplinary courses			
MU-001E	Certificate Course in Bioinformatics	3	School of Life Sciences, MU
MU-002E	Project Management	4	Department of Humanities and Social Science, MIT
MU-003E	Certificate Course in Bioethics	2/4	Centre for Bioethics, MU
MU-004E	Academic Research and Writing	3	Manipal Centre for Philosophy and Humanities, MU
MU-005E	Certificate Course in Biosecurity	5	Dept. of Public Health, MU
CR-001E	Any one of the Online courses	1 and above	Coursera

10. Program committee

1. The MPharm program shall have a program committee constituted by the Head of the Institution in consultation with all the Heads of the Departments.

2. The composition of the program committee shall be as follows: A teacher at the cadre of professor shall be the Chairperson; One teacher from each MPharm specialization and four student representatives (two from each academic year), nominated by the Head of the Institution.

3. Duties of the program committee:

i. Periodically reviewing the progress of the classes.
ii. Discussing the problems concerning curriculum, syllabus and the conduct of classes.
iii. Discussing with the course teachers on the nature and scope of assessment for the course and the same shall be announced to the students at the beginning of respective semesters.
iv. Communicating its recommendation to the Head of the Institution on academic matters.
v. The program committee shall meet at least twice in a semester, preferably at the end of each sessional exam and before the end semester exam.

11. Examinations/Assessments

The schemes for internal assessment and end-semester examinations are given in Table 16.

Table 16. Schemes for internal assessments and end semester examinations

Course	Internal Assessment				End-Semester Exams		Total Marks
	Continuous Mode	Sessional Exams		Total	Marks	Duration	
		Marks	Duration				
Semester I and II							
Theory	10	15	1 hr each	25	75	3 hrs	100
Practical	20	30	6 hrs	50	100	6 hrs	150
Seminar	--	--	--	100	--	--	100
Semester III and IV							
PHA-MRM301T Research Methodology and Biostatistics*	20	40+40	2 hrs each	100	--	--	100
MJC302P Journal Club*	--	--	--	100	--	--	100
MRW401P Research Work	--	100+100	1 hr each	200	400	--	600
***** No end-semester examination. Only continuous mode							

11.1. Internal assessment: Continuous mode

The marks allocated for continuous mode of internal assessment of theory courses shall be awarded based on the students' performance in the assignments/surprise tests, etc., while in the lab course it is based on the practical record, regular viva-voce etc.

11.1.1. Sessional exams

Two sessional exams for each theory course and one sessional examination for a practical course shall be conducted as per the schedule fixed by the college. The schemes of question papers for theory and practical sessional examinations are given below. The average marks of two sessional examinations of theory courses shall be computed for internal assessment of 15 marks as given in Table 16.

Question paper pattern – MPharm Theory sessional examinations		
Manipal College of Pharmaceutical Sciences **Manipal Academy of Higher Education, Manipal** **MPharm Theory Sessional Examinations, Month and Year** **Course Code. Course Title**		
Date: dd-mm-yyyy	Duration: 2 hrs	Max. Marks: 45
Instructions: Answer ALL questions		
Long Essays (2x 10 marks) = 20 marks 1. Question 2. Question Short Essays (4 x 5 marks) = 20 marks 3. Question 4. Question 5. Question 6. Question 7. Short answers (1 mark × 5 = 5 marks) 7A. 7B. 7C. 7D. 7E.		

Question paper pattern – MPharm practical sessional examinations
Manipal College of Pharmaceutical Sciences **Manipal Academy of Higher Education, Manipal** **MPharm Practical Sessional Examinations, Month and Year** **Course Code. Course Title** Date: dd-mm-yyyy Duration: 6 hrs Max. Marks: 60 **Instructions: Answer ALL questions.** 1. Synopsis (10 marks) 2. Major Experiment (25 marks) 3. Minor Experiment (15 marks) 4. Viva-Voce (10 marks)

MPharm seminar evaluation scheme					
PRESENTATION (50 Marks)				**Marks awarded for each criteria**	
Criteria				Teacher 1	Teacher 2
1	Preparedness (10 marks)				
2	Response to questions (10 marks)				
3	Audio-visual aids (10 marks)				
4	Clarity of presentation (10 marks)				
5	Breadth and depth of material presented (10 marks)				
			Marks awarded		
			Average marks awarded for presentation out of 50 (A) =		
WRITE UP (50 Marks)					
Marks awarded for each criterion					Marks awarded for write up out of 50 (B)
Content (optimum and relevant to topic) (10 marks)	Recent information or out of date (10 marks)	Organization (sequent and methodical) (10 marks)	Diagram, illustrations & references (10 marks)	Originality (10 marks)	
Remarks if any:					
Seminar marks awarded out of 100 = (A+B) =					

11.2 End-semester examination

End-semester examinations are conducted for eligible students twice at the end of the semester, namely, the main examination for regular students and the make-up/supplementary examinations for the failed students only before the commencement of the next semester (Table 17). In case a failed student could not clear the course in the make-up/supplementary examination, the student would have his next examination along with the regular students only in the main examination.

Table 17. Tentative schedule of end-semester examinations		
Semester	**Main Examination**	**Make-up/Supplementary Exams**
I and III	November/December	December/January
II and IV	May/June	July/August

Question paper pattern – MPharm theory end-semester examinations

Manipal Academy of Higher Education, Manipal

MPharm Theory End-Semester Examinations, Month and Year

Course Code. Course Title

Date: dd-mm-yyyy Duration: 3 hrs Max. Marks: 75

Instructions: Answer ALL questions.

Answer the following (5 marks × 10 = 50 marks)
1. Question
2. Question
3. Question
4. Question
5. Question

Answer the following with specific answers (5 marks × 5 = 25 marks)
6A.
6B.
6C.
6D.
6E.

Question paper pattern – MPharm practical end-semester examinations

MPharm Practical End-Semester Examinations, Month and Year

Manipal Academy of Higher Education, Manipal

Course Code. Course Title

Date: dd-mm-yyyy Duration: 6 hrs Max.Marks: 100

Instructions: Answer ALL questions.

1. Synopsis (15 marks)
2. Major Experiment (45 marks)
3. Minor Experiment (25 marks)
4. Viva-Voce (15 marks)

12. Pass and award of performance grades

12.1: Minimum for a pass in a course

A student should obtain a minimum of 35% marks in the end-semester exam of each course. A student shall be declared PASS if, the candidate secures E-grade separately in each course, in a

10-Point-Relative-Letter Grading-Scheme. Accordingly, no candidate shall be declared to have passed in any course unless he/she obtains a grade not less than E-grade.

12.2 Award of performance grades

The marks obtained in the end semester and internal assessments in a course are added together and a 10-Point-Relative-Letter Grading Scheme is used to allot an appropriate letter grade to the student's performance in that course.

12.3 The 10-Point-Relative-Letter-Grading- Scheme

The letter grades and grade points that are used to assess the students' performance in a course are given in the Table 18

Table 18. 10-Point-Relative-Letter Grading-Scheme

Letter Grade	Grade Point	Performance
A+	10	Outstanding
A	9	Excellent
B	8	Good
C	7	Fair
D	6	Average
E	5	Pass
F/I/DT/ab	0	Fail

F: Fails, I: Incomplete, DT: Detained, ab: Absent

Note the following:

1. Internal assessment marks and end-semester examination marks put together are taken into account for the 10-Point-Relative-Letter Grading-Scheme in each course separately. However, the scheme is applied to a student who scores minimum 35% marks in the end-semester examination of each course.
2. Appropriate letter grades, from E to A+, are awarded, in each theory and lab courses, to only such candidate who has passed the course in first attempt. However, grades E to C are only awarded to a student who makes multiple attempts to pass a course; except in case of I-grade.
3. A candidate who is eligible and registers for the end-semester examination but fails to appear in the end-semester examination or fails in the course gets a grade 'ab', indicating failure.
4. A student who is eligible and registers for the end-semester examination but fails to appear in the end-semester examination due to valid reasons will get a grade 'I', indicating incomplete. However, it needs prior approval of the HOI and the Registrar Evaluation, Manipal Academy of Higher Education.
5. The grade DT is given to a candidate who fails to put in the minimum required attendance for appearing the end-semester examination for a course.
6. A student who earns a grade 'E' or above in a course is declared to have successfully completed the course and earns the credits assigned to that particular course. A course successfully completed cannot be repeated for the purpose of improving the grade.
7. Final evaluation of the performance of a student in each course (theory and lab separately) will be carried out on a 10-Point-Letter Grading-Scheme corresponding to the marks obtained in that course. Eventually each letter grade of the course is converted into a specific grade point associated with the letter grade as given in the table above.

12.4 The Semester Grade Point Average (SGPA)

Note: For the calculation of SGPA and CGPA, the credits assigned for course work are only taken for account.

The performance of a student in a semester is indicated by a number called 'Semester Grade Point Average' (SGPA). The SGPA is the weighted average of the grade points obtained in all the courses by the student during the semester. For example, if a student takes four courses (Theory/Practical) in a semester with credits C1, C2, C3 and C4 and the student's grade points in these courses are G1, G2, G3 and G4, respectively, and then students' SGPA is equal to:

$$\mathrm{SGPA} = \frac{\mathrm{C1G1} + \mathrm{C2G2} + \mathrm{C3G3} + \mathrm{C4G4}}{\mathrm{C1} + \mathrm{C2} + \mathrm{C3} + \mathrm{C4}}$$

The SGPA is calculated to two decimal points. It should be noted that, the SGPA for any semester shall take into consideration the F and ab-grade awarded in that semester. For example if a learner has F or ab-grade in course 4, the SGPA shall then be computed as:

$$\mathrm{SGPA} = \frac{\mathrm{C1G1} + \mathrm{C2G2} + \mathrm{C3G3} + \mathrm{C4} * \mathrm{ZERO}}{\mathrm{C1} + \mathrm{C2} + \mathrm{C3} + \mathrm{C4}}$$

12.5. Cumulative Grade Point Average (CGPA)

The CGPA is calculated with the SGPA of all the IV semesters to two decimal points and is indicated in the final grade report card/final transcript showing the grades of all IV semesters and their courses. The CGPA shall reflect the failed status in case of F grade(s), till the course(s) is/are passed. When the course(s) is/are passed by obtaining a pass grade on subsequent examination(s) the CGPA shall only reflect the new grade and not the fail grades earned earlier. The CGPA is calculated as:

$$\mathrm{CGPA} = \frac{\mathrm{C1S1} + \mathrm{C2S2} + \mathrm{C3S3} + \mathrm{C4S4}}{\mathrm{C1} + \mathrm{C2} + \mathrm{C3} + \mathrm{C4}}$$

where C1, C2, C3,.... is the total number of credits for semester I,II,III,…. and S1,S2, S3,....is the SGPA of semester I,II,III,…. .

12.6. Conversion of GPA/CGPA into a percentage

The performance of students who are pursuing pharmacy programs in the Manipal College of Pharmaceutical Sciences, Manipal Academy of Higher Education, Manipal is awarded on a 10-Point-Relative-Letter Grading-Scheme.

In this system the top band (top 10%) of students who score highest marks are placed at A+ which is equivalent to 10 grade point (maximum). Thus, 10 GPA or CGPA is equivalent to 100%. Accordingly, 1 GPA or CGPA is equivalent to 10%.

Based on this, the following formula is applied to convert GPA or CGPA to an appropriate percentage:

Percentage secured by the candidate = GPA or CGPA × 10

13. Make-up/Supplementary examination

In case, a student fails to secure an E-grade in any theory or practical courses, he/she shall reappear for the end-semester examination of that course. However, his/her marks of the internal assessment shall be carried over, and he/she is entitled for a maximum grade of 'C' only, irrespective of the students' top order performances.

However, the candidates with DT-grade will also be allowed to take this examination provided they meet the eligibility criteria laid for the candidates to appear in the end-semester examinations of the courses of the programs.

Important to Note: A student who once failed (F-grade) or DT (Detained) grade in any course, a maximum of C-grade will only be awarded in subsequent end-semester examinations, irrespective of the student's high performances in that particular course. However, those who miss regular examinations due to valid reasons (I-grade) will be allowed to retain whatever the grades they secure in the make-up/supplementary examinations. In case a candidate with DT-grade reregisters for the course to repeat the entire education process in the subsequent academic year, after paying the required course fee, the DT status in that particular course is removed and he/she is allowed to retain the grades that he/she secures in the end-semester examination.

After the results are declared, grade cards will be issued to each student, which will contain the list of courses for that semester and the grades obtained by the student.

14. Improvement of internal assessment

A student shall have the opportunity to improve his/her performance only once in the sessional exam component of the internal assessment. The re-conduct of the sessional exam shall be completed before the commencement of next end-semester theory examinations.

15. Promotion to the next higher class

A student shall be eligible to carry forward all the courses of I and II semesters till the III/IV semester examinations. However, the results of IV semester (Research project) of the student shall be declared only when the student passes in all the courses of I and II semesters.

16. Declaration of class

The class shall be awarded on the basis of CGPA as follows:

First Class with Distinction	= CGPA of 7.50 and above
First Class	= CGPA of 6.00 to 7.49
Second Class	= CGPA of 5.00 to 5.99

17. Research project work

17.1 Dissertation submission

All the students shall undertake a research project under the supervision of a teacher in semester III and IV and submit a dissertation at the end of the IV semester. Four copies of the dissertation shall be submitted.

Note: If any candidate fails to submit the dissertation on or before the date prescribed, the end-semester examination of such candidate shall be at a later date, which shall not be earlier than 6 months from the date fixed in the first instance.

17.2 Dissertation evaluation

The performance of student in the dissertation work is assessed as per the scheme given in the Table 19.

Table 19. MPharm dissertation evaluation scheme

Internal Assessment			**University Examination**					**Grand Total**
Presentation 1 (III semester)	**Presentation 2 (IV semester)**	**Total**	**Dissertation Evaluation (300) by Examiners**		**Viva Voce Joint Evaluation by Internal and External Examiners (100)**		**Total**	
			Internal	External	Presentation	Viva-voce		
i	ii	i+ii=A	i	ii	iii	iv	i+ii+iii+iv =B	A+B
100	**100**	**200**	**150**	**150**	**50**	**50**	**400**	**600**

The internal and external examiners appointed by the university shall evaluate the dissertation of the research project separately as per the following evaluation criteria.

Evaluation of Dissertation: For 150 marks each separately by Internal and External Examiners

	Marks
Objective(s) of the study	25
Literature search	25
Methodology adopted	30
Results and discussions	30
Conclusions and outcomes	20
Bibliography	20
Total	**150**

Evaluation of Presentation and Viva-voce: For 100 marks jointly by Internal and External Examiners

	Marks
Presentation of work	30
Communication skills	20
Total	**50**

Viva-voce	**50**

18. Award of degree

Candidates who fulfill the requirements mentioned above shall be eligible for award of degree.

19. Duration for completion of the program

The duration for the completion of the program shall be four academic years (double the duration of the prescribed duration). In case, a student is not able to complete the program within this period, the candidate has to reregister for the program.

20. Revaluation of answer papers

There is a provision for revaluation of the answer papers of the end-semester examination as per Manipal Academy of Higher Education policy, however, the candidates have to apply separately by paying the prescribed fee.

21. Re-admission after break of study

The candidate who seeks re-admission to the program after taking a break of the study, has to get the approval from the university.

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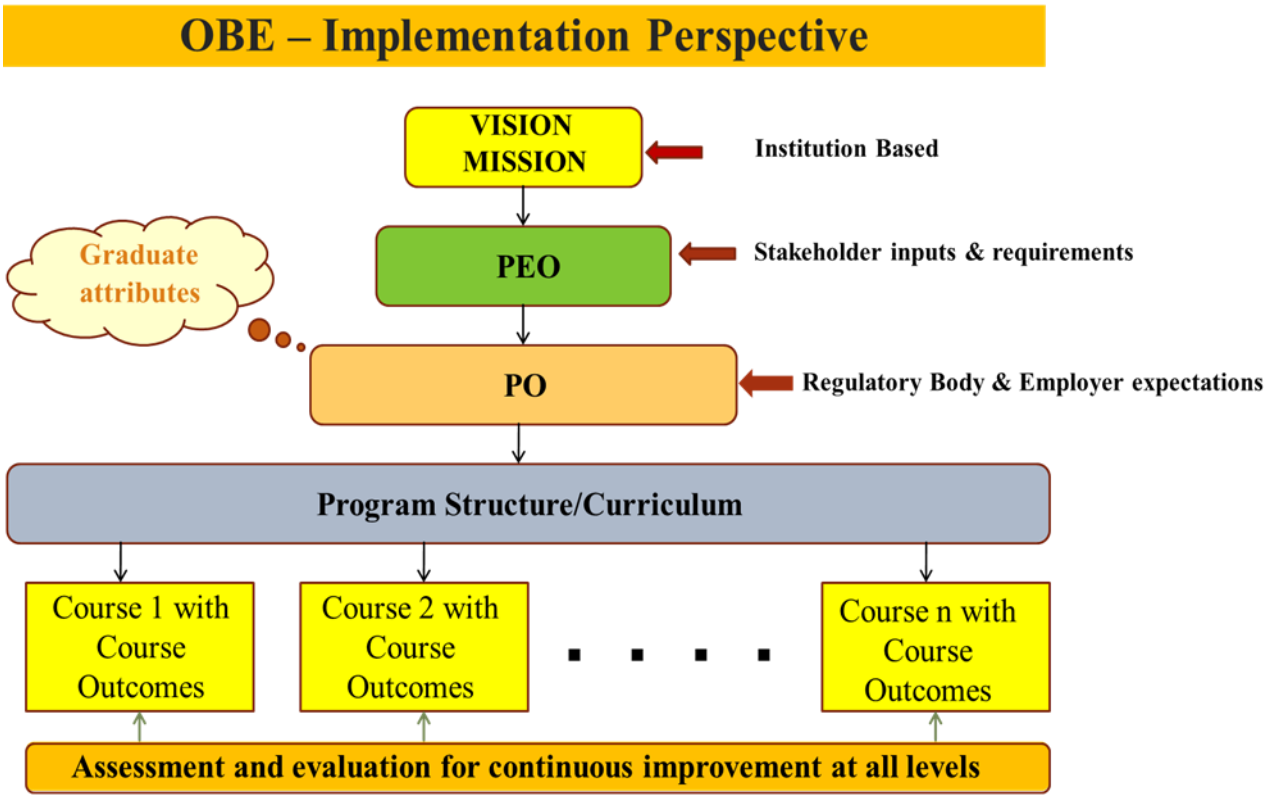
OUTCOME BASED EDUCATION (OBE) FRAMEWORK

Chapter II

Outcome Based Education (OBE) Framework



MCOPS Vision Mission

Vision:

"Excellence in Pharmaceutical Education and Research"

Mission:

"Marching with the Times"

Quality Policy

- **MCOPS is committed towards providing value-based pharmaceutical education to meet industry, hospital and community needs through continuous improvement of infrastructure and facility for learning, practice and research.**

- **MCOPS shall provide an environment conducive to the development of staff and students.**

MPharm Pharmacognosy Program Educational Objectives

The Department of Pharmacognosy, Manipal College of Pharmaceutical Sciences, accomplishes to cultivate an attitude conducive to self-learning and lifelong learning that would

PEO No	Education Objective
PEO 1	Develop an education leading to a Masters' degree in Pharmacognosy providing thorough understanding of natural products specifically encompasses the study of secondary metabolites of potential medical applications leading to drug discovery and development.
PEO 2	Gear with comprehensive knowledge and skills to deliver service in identification, isolation, characterization, formulation and standardization of natural drugs integrating with allied fields leading to effective natural product research
PEO 3	Raise an inclination for higher education, entrepreneurship and outline solutions for intricate research problems through Pharmacognostical strategies leading to drug discovery.
PEO 4	Foster the best in class experimental hands-on training in bioactivity guided fractionation, fingerprinting of phytoconstituents, design and development of herbal formulation using modern analytical techniques.
PEO 5	Enable and refine pharmacognosists to serve as a liaison among traditional and modern medicine, steering the way for future directional natural products research safeguarding natural resources and economic standing for the future

MPharm Pharmacognosy Program Outcomes (POs)

After successful completion of M Pharm Pharmacognosy program, students will be able to:

PO No	Attribute	Competency
PO1	**Domain knowledge**	Apply the core knowledge of Pharmacognosy and Phytochemistry in drug discovery and development process.
PO 2	**Problem analysis**	Identify, authenticate, analyse eco-variations, contaminants that pose regulatory issues in herbal drug research.
PO 3	**Design/develop solutions**	Outline solutions for intricate research problems through Pharmacognostical strategies with traditional system of medicine.
PO 4	**Conduct investigations of complex problems**	Conceptualize and evaluate problems to draw meaningful conclusions through hypothesis in isolation and characterization of novel compounds and design of dosage forms.
PO 5	**Modern tool usage**	Learn, select, apply appropriate tools in phytochemical fingerprinting using HPTLC, HPLC, and characterization of phytoconstituents by spectral studies of herbal extracts.
PO 6	**Business and society**	Adapt and facilitate a multi-disciplinary approach in allied fields of pharmacy and pharmacognosy to develop business modules in R&D, consultancy and contract research.
PO 7	**Environment and sustainability**	Comprehend the ecological, environmental, and resource economics impact on society and to exhibit the knowledge for sustainable augmentation
PO 8	**Ethics**	Solicit righteous principles for the allegiance of professional responsibilities
PO 9	**Individual/ team work**	Function effectively as a private, and as a member or as a front runner in various groups, and in multidisciplinary settings for collaboration.

PO No	Attribute	Competency
PO 10	**Communication**	Build overall personality by instilling soft skills for the effective communication of ideas to present the scientific reports in a comprehensive but focussed approach.
PO 11	**Project management and finance**	Exhibit the literacy of the monetary management to judge new and existing projects for effective deciding
PO 12	**Life-long learning**	Recognize the need for continuous upgradation of their knowledge and skills

CHAPTER – III

- **Course Work**
- **COs POs Mapping**
- **Course Outcomes**
- **Course Content and Assessment Plan**
- **Syllabus in detail**

Course work of MPharm – Pharmacognosy (MPG) specialization						
Course Code	**Course Title**	**Credit hours/week**			**Credit Points**	**Marks**
		Lecture (L)	**Tutorial (T)**	**Practical (P)**		
Semester I						
PQA-MPG101T	Modern Pharmaceutical Analytical Techniques	4	--	--	4	100
PCO-MPG102T	Advanced Pharmacognosy I	4	1	--	5	100
PCO-MPG103T	Phytochemistry	4	1	--	5	100
PCO-MPG104T	Industrial Pharmacognostical Technology	4	1	--	5	100
PCO-MPG105P	Pharmacognosy Practical I	--	--	12	6	150
PCO-MPG106S	Seminar*	--	--	2	1	100
	Total	**16**	**3**	**14**	**26**	**650**
Semester II						
PCO-MPG201T	Medicinal Plant Biotechnology	4	1	--	5	100
PCO-MPG202T	Advanced Pharmacognosy II	4	1	--	5	100
PCO-MPG203T	Indian Systems of Medicine	4	1	--	5	100
PCO-MPG204T	Herbal Cosmetics	4	1	--	5	100
PCO-MPG205P	Pharmacognosy Practical II	--	--	12	6	150
PCO-MPG206S	Seminar*	--	--	2	1	100
	Total	**16**	**4**	**14**	**27**	**650**

Course work for MPharm III and IV semesters (Common for all specializations)						
Course Code	**Course Title**	**Credit hours/week**			**Credit Points**	**Marks**
		Lecture (L)	**Tutorial (T)**	**Practical (P)**		
PHA-MRM301T	Research Methodology and Biostatistics*	**4**	**--**	**--**	**4**	**100**
MJC302P	Journal Club*	**--**	**--**	**2**	**1**	**100**
MRW401P	Research Work	**--**	**--**	**70**	**35**	**600**
	Total	**4**	**--**	**72**	**40**	**800**
***** No end-semester examination.						

PROGRAM OUTCOMES (POs) AND COURSE OUTCOMES (COs) MAPPING

S No	Course Code	Course Name	Credits	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1O	PO11	PO12
1	PQA-MPG101T	Modern Pharmaceutical Analytical Techniques	4	CO1 CO2 CO3	CO1 CO2 CO3	CO1 CO2 CO3	CO1	CO1 CO2 CO3	CO1	CO1 CO2 CO3	CO1 CO2 CO3	CO3	CO1 CO3	CO1 CO2 CO3	CO1 CO3
2	PCO-MPG102T	Advanced Pharmacognosy I	5	CO1 CO2 CO3 CO4 CO5	CO1 CO2 CO3 CO4 CO5	CO3 CO4	CO2	CO2 CO3 CO4	CO1 CO2 CO3 CO4 CO5	CO1 CO2 CO4					CO1 CO4
3	PCO-MPG103T	Phytochemistry	5	CO1 CO2 CO3 CO4 CO5			CO3	CO1 CO4 CO5							
4	PCO-MPG104T	Industrial Pharmacognostical Technology	5	CO1 CO2 CO3 CO4 CO5	CO1 CO2 CO3 CO4 CO5	CO1 CO3	CO1	CO1 CO3 CO4	CO1 CO2 CO5	CO1	CO4	CO1 CO2 CO4		CO1 CO2 CO5	
5	PCO-MPG105P	Pharmacognosy Practical I	6	CO1 CO2 CO3	CO1 CO2 CO3	CO1 CO2 CO3	CO2 CO3	CO2 CO3	CO1 CO2 CO3						
6	PCO-MPG106S	Seminar*	1	CO1	CO1 CO2	CO2 CO5						CO3	CO3 CO4 CO5		CO6
7	PCO-MPG201T	Medicinal Plant Biotechnology	5	CO1 CO2 CO3 CO4 CO5					CO1 CO4 CO5						
8	PCO-MPG202T	Advanced Pharmacognosy II	5	CO1 CO2 CO3 CO4 CO5	CO1 CO2 CO3 CO4 CO5	CO1 CO2 CO3 CO4 CO5		CO1 CO2 CO4	CO1 CO3 CO5	CO3	CO5				CO4 CO5

S No	Course Code	Course Name	Credits	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1O	PO11	PO12
9	PCO-MPG203T	Indian Systems of Medicine	5	CO1 CO2 CO3 CO4 CO5	CO3 CO4 CO5	CO1 CO3 CO3		CO3							
10	PCO-MPG204T	Herbal Cosmetics	5	CO1 CO2 CO3 CO4 CO5	CO1 CO3 CO5	CO1 CO2	CO3 CO4	CO2 CO3 CO5	CO1 CO3 CO4	CO2	CO5			CO1	
11	PCO-MPG205P	Pharmacognosy Practical II	6	CO1 CO2 CO3	CO3		CO3	CO2 CO3							
12	PCO-MPG206S	Seminar*	1	CO1	CO1 CO2		CO2 CO5					CO3	CO3 CO4 CO5		CO6
13	PHA-MRM301T	Research Methodology and Biostatistics*	4	CO1		CO1	CO2	CO2						CO1	
14	MJC302P	Journal Club*	1	CO1	CO1		CO1					CO2 CO3	CO3		CO4
15	MRW401P	Research Work	35	CO1	CO1	CO4	CO5	CO5	CO6	CO3	CO3		CO5 CO6	CO2	

Chapter III
MPHARM – PHARMACOGNOSY (MPG)

SEMESTER I
PQA-MPG101T: MODERN PHARMACEUTICAL ANALYTICAL TECHNIQUES

COURSE CODE	PQA-MPG 101T
COURSE TITLE	MODERN PHARMACEUTICAL ANALYTICAL TECHNIQUES (Theory)

SCOPE/SUMMARY	**OBJECTIVES/COURSE OUTCOMES**
This course deals with various advanced analytical instrumental techniques for identification, characterization and quantification of drugs. Instruments dealt are NMR, Mass spectrometer, IR, HPLC, GC etc.	After completion of the course, a student will be able to understand: 1. The theory, instrumentation & applications of UV visible spectroscopy, IR, Fluorimetry & AES. 2. The theory, instrumentation & applications of NMR spectroscopy. 3. The theory, instrumentation & applications of Mass spectrometry. 4. The theory, instrumentation & applications of of chromatographic technique. 5. The theory, instrumentation & applications of electrophoresis, XRD, polarimetry, thermal & immunological assays.

Course Content and Assessment Plan

Sl. No.	**Course Content**	**Syllabus (Chapters or Units with hours)**	**Total Marks of assessment**	**Distribution of marks of assessment**		
				Sessional exam *(**30** % of total marks of assessment)*		**End Sem exam** *(**70** % of total marks of assessment)*
				S1	**S2**	
1	Will know about theory, instrumentation and application of various spectroscopic techniques.	Unit I (15 hrs)	30	10		20
2	Will know about the theory, instrumentation and applications of NMR spectroscopy.	Unit II (8 hrs)	15	5		10
3	Will know about the theory, instrumentation and applications of Mass spectrometry.	Unit III (6 hrs)	13		3	10
4	Will know about the theory, instrumentation and applications of various chromatographic techniques.	Unit IV (8 hrs)	19		4	15
5	Will know about the theory, applications of electrophoresis, X-ray crystallography, Potentiometry, Thermal techniques and Immuno assays.	Unit V (15 hrs)	28		8	20
		Total Marks of Assessment	105	15	15	75

PQA-MPG101T: MODERN PHARMACEUTICAL ANALYTICAL TECHNIQUES

THEORY **52 hrs**

1.a. **UV-Visible Spectroscopy**: Introduction, theory, laws, instrumentation associated with UV-Visible spectroscopy, choice of solvents and solvent effect and applications of UV-Visible spectroscopy, Difference/ Derivative spectroscopy. **5 hrs**

b. **IR Spectroscopy**: Theory, modes of molecular vibrations, sample handling, instrumentation of dispersive and Fourier-Transform IR spectrometer, factors affecting vibrational frequencies and applications of IR spectroscopy. **5 hrs**

c. **Spectroflourimetry**: Theory of fluorescence, factors affecting fluorescence, quenchers, instrumentation and applications of fluorescence spectrophotometry. **2 hrs**

d. **Flame Emission Spectroscopy** and atomic absorption spectroscopy: Principle, instrumentation, interferences and applications. **3 hrs**

2. **NMR Spectroscopy**: Quantum numbers and their role in NMR, principle, instrumentation, solvent requirement in NMR, relaxation process, NMR signals in various compounds, chemical shift, factors influencing chemical shift, Spin-Spin coupling, coupling constant, nuclear magnetic double resonance, brief outline of principles of FT-NMR and 13C NMR. Applications of NMR spectroscopy. **8 hrs**

3. **Mass Spectroscopy**: Principle, theory, instrumentation of mass spectroscopy, different types of ionization like electron impact, chemical, field, FAB and MALDI, APCI, ESI, APPI analyzers of quadrupole and time of flight, mass fragmentation and its rules, meta stable ions, isotopic peaks and applications of mass spectroscopy. **6 hrs**

4. **Chromatography**: Principle, apparatus/instrumentation, chromatographic parameters, factors affecting resolution and applications of the following:

a) Planar chromatography-Paper, Thin layer chromatography and High performance thin layer chromatography b) Ion exchange chromatography c) Column chromatography d) Gas chromatography e) High performance liquid chromatography and ultra-high performance liquid chromatography f) Affinity chromatography g) Gel chromatography. **8 hrs**

5. Other Analytical Techniques

a**. Electrophoresis**: Principle, instrumentation, working conditions, factors affecting separation and applications of the following: a) Paper electrophoresis b) Gel electrophoresis

c) Capillary electrophoresis d) Zone electrophoresis e) Moving boundary electrophoresis f) Iso electric focusing. **3 hrs**

b. **X-ray Crystallography**: Different X-ray diffraction methods, Bragg's law, Rotating crystal technique, X-ray powder technique, types of crystals and applications of X-ray diffraction. **2 hrs**

c. **Potentiometry**: Principle and application of potentiometry. **2 hrs**

d. **Thermal Techniques**: Principle and application of Differential Scanning Calorimetry, Differential Thermal Analysis and Thermo Gravimetric Analysis. **5 hrs**

e. **Immunological Assays**: RIA (Radio immuno assay), ELISA. **3 hrs**

REFERENCES

1. Spectrometric Identification of Organic Compounds, Robert M Silverstein, 6th edition, John Wiley & Sons, 2004.
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6. Quantitative Analysis of Drugs in Pharmaceutical Formulation, PD Sethi, 3rd edition, CBS Publishers, New Delhi, 1997.
7. Pharmaceutical Analysis-Modern Methods, Part B, J W Munson, Volume11, Marcel Dekker Series.
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9. Contemporary Practice of Chromatography, Poole, Colin F and Sheila A Schuette, Elsevier Science Publishers.
10. Remington: The Science and Practice of Pharmacy, latest edition, Pharmaceutical Press, UK.
11. Quantitative Analysis of Pharmaceutical Formulations by HPTLC, PD Sethi, CBS Publishers, New Delhi.

MPHARM – PHARMACOGNOSY (MPG)

SEMESTER I

PCO-MPG 102T: ADVANCED PHARMACOGNOSY I

COURSE CODE	PCO-MPG102T
COURSE TITLE	ADVANCED PHARMACOGNOSY I (Theory)

SCOPE/SUMMARY	**OBJECTIVES/COURSE OUTCOMES**
To learn and understand the advances in the field of cultivation and isolation of drugs of natural origin, various phytopharmaceuticals, Nutraceuticals, and their medicinal and health benefits	Upon completion of this course the student should be able to: 1. Describe advances in the cultivation and production of drugs 2. Understand the drugs of marine origin 3. Explain the various nutraceuticals/herbs and their health benefits 4. Discuss the various phytopharmaceuticals and their source, its utilization and medicinal value 5. Understand pharmacovigilance of drugs of natural origin

Course Content and Assessment Plan

Sr No.	**Course Content**	**Syllabus (Chapters or Units with hours)**	**Total Marks of assessment**	**Distribution of marks of assessment**		
				Sessional exam (*30 % of total marks of assessment)*		**End Sem exam** (**7***0 % of total marks of assessment)*
				S1	**S2**	
1	Shall gain knowledge in cultivation of medicinal plants as per good agricultural practices and conservation of medicinal plants	Unit I (10 hrs)	20	08		12
2	Will learn the general methods of isolation, purification and recent advances in research in marine drugs	Unit II (10hrs)	20		07	13
3	Learn the aspects of nutraceuticals, including the current trends, future scope, classification, health benefits regulatory aspects and FSSAI guidelines	Unit III (10 hrs)	20		08	12
4	Shall gain knowledge in phytopharmaceuticals comprising of occurrence, isolation, chemical nature and health benefits of	Unit IV (12 hrs)	25			25

	certain commercially useful phtopharmaceuticals					
5	Shall gain knowledge in pharmacovigilance of drugs of natural origin, safety monitoring and drug interactions	Unit V (10 hrs)	20	07		13
Total Marks of Assessment			105	15	15	75

PCO-MPG 102T: ADVANCED PHARMACOGNOSY I

THEORY **52 hrs**

1. Plant drug cultivation: General introduction to the importance of Pharmacognosy in herbal drug industry, Indian Council of Agricultural Research, Current Good Agricultural Practices, Current Good Cultivation Practices, Current Good Collection Practices, Conservation of medicinal plants – *Ex situ* and *In situ* conservation of medicinal plants. **10 hrs**

2 Marine natural products: General methods of isolation and purification, Study of marine toxins, recent advances in research in marine drugs, problems faced in research on marine drugs such as taxonomical identification, chemical screening and their solution. **10 hrs**

3 Nutraceuticals: Current trends and future scope, inorganic mineral supplements, vitamin supplements, digestive enzymes, dietary fibers, cereals and grains, health drinks of natural origin, antioxidants, polyunsaturated fatty acids, herbs as functional foods, formulation and standardization of nutraceuticals, regulatory aspects, FSSAI guidelines, sources, name of marker compounds and their chemical nature, medicinal uses and health benefits of following i) Spirulina ii) Soy bean iii) Ginseng iv) Garlic v) Broccoli vi) Green and Herbal teas vii) Flax seeds viii) Black cohosh ix) Turmeric. **10 hrs**

4 Phytopharmaceuticals: Occurrence, isolation and characteristics features (chemical nature, uses in pharmacy, medicinal and health benefits) of following. **12 hrs**

a) Carotenoids – i) α and β-Carotene ii) Xanthophyll (Lutein)
b) Limonoids – i) d-Limonene ii) α-Terpineol
c) Saponins – i) Shatavarins
d) Flavonoids–i) Resveratrol ii) Rutin iii) Hesperidin iv) Naringin v) Quercetin
e) Phenolic acids- Ellagic acid

f) Vitamins

g) Tocotrienols and Tocopherols

h) Andrographolides, Glycolipids, Guggulipids, Withanolides, Vasicine, Taxol

i) Miscellaneous

5 Pharmacovigilance of drugs of natural origin: WHO and AYUSH guidelines for safety monitoring of natural medicine, spontaneous reporting schemes for biodrug adverse reactions, bio drug-drug and bio drug-food interactions with suitable examples. **10 hrs**

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2. Pharmacognosy-Tyler, Brady, Robbers
3. Modem Methods of Plant Analysis- Peach & M.V. Tracey, Vol. I&II 4. Text Book of Pharmacognosy by T.E. Wallis
4. Marine Natural Products-Vol.I to IV.
5. Natural Products: A Lab Guide by Raphael Ikan, Academic Press 1991.
6. Glimpses of Indian Ethano Pharmacology, P. Pushpangadam. Ulf Nyman. V.George Tropical Botanic Garden & Research Institute, 1995.
7. Medicinal Natural Products (a biosynthetic approach), Paul M. Dewick, John Wiley & Sons Ltd., England, 1998.
8. Chemistry of Marine Natural Products- Paul J. Schewer 1973.
9. Herbal Drug Industry by RD. Choudhary, Eastern Publisher, New Delhi, 1996.
10. Cultivation of Medicinal Plants by C.K. Atal & B.M. Kapoor.
11. Cultivation and Utilization of Aromatic Plants, C.K. Atal & B.M. Kapoor
12. Cultivation of Medicinal and Aromatic Crops, AA Farooqui and B.S. Sreeramu. University Press, 2001.
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15. Text book of Pharmacognosy, C.K.Kokate, Purohit, Ghokhale, Nirali Prakasshan, 1996.
16. Pharmacognosy and Pharmacobiotechnology, Ashutoshkar, New Age Publications, New Delhi.

MPHARM – PHARMACOGNOSY (MPG)

SEMESTER I

PCO-MPG 103T: PHYTOCHEMISTRY

COURSE CODE	**PCO- MPG103T**
COURSE TITLE	**PHYTOCHEMISTRY** (Theory)

SCOPE/SUMMARY	**OBJECTIVES/COURSE OUTCOMES**
Students shall be equipped with the knowledge of natural product drug discovery and will be able to isolate, identify and extract the phytoconstituents	Upon completion of the course, the student shall be able to know the, 1. Different classes of phytoconstituents, their biosynthetic pathways, isolation, purification and characterization 2. Information about the herbal drug discovery and development 3. Various conventional / advanced extraction methods, separation and chromatographic techniques for herbal drugs 4. Phytochemical fingerprinting for phytoconstituents 5. Various spectroscopic techniques for structure elucidation of phytoconstituents.

Course Content and Assessment Plan

Sl. No.	**Course Content**	**Syllabus (Chapters or Units with hours)**	**Total Marks of assessment**	**Distribution of Marks of Assessment**		
				Sessional exam (*30 % of total marks of assessment)*		**End Sem exam** (**7***0 % of total marks of assessment)*
				S1	**S2**	
1	Will gain the knowledge about the biosynthetic pathways of various phytoconstituents and radio tracing techniques	Unit I (10 hrs)	20	08		12
2	Will get the information about the herbal drug discovery and development	Unit II (10 hrs)	20	07		13
3	Will gain the knowledge about recent advances in extraction technology	Unit IV (10 hrs)	20		07	13
4	Will get information about phytochemical finger printing	Unit III (12 hrs)	25		08	17

5	Will gain knowledge about structure elucidation of various phytochemicals by spectroscopic techniques	Unit V (10 hrs)	20			20
Total Marks of Assessment			105	15	15	75

MPG 103T: PHYTOCHEMISTRY

THEORY **52 hrs**

1. Biosynthetic pathways and Radio tracing techniques: Constituents & their biosynthesis, isolation, characterization and purification with a special reference to their importance in herbal industries of following phyto-pharmaceuticals containing drugs: **10 hrs**
   a) Alkaloids: Ephedrine, Quinine, Strychynine, Piperine, Berberine, Taxol, Vinca alkaloids.
   b) Glycosides: Digitoxin, Glycyrrhizin, Sennosides, Bacosides, Quercetin.
   c) Steroids: Hecogenin, Guggulosterone and Withanolides
   d) Coumarin: Umbelliferone
   e) Terpenoids: Cucurbitacins

2. Drug discovery and development: History of herbs as source of drugs and drug discovery, the lead structure selection process, structure development, product discovery process and drug registration, selection and optimization of lead compounds with suitable examples from the following source: artemisin, andrographolides. Clinical studies emphasizing on phases of clinical trials, protocol design for lead molecules. **10 hrs**

3. Extraction and Phytochemical studies: Recent advances in extractions **10 hrs** with emphasis on selection of method and choice of solvent for extraction, successive and exhaustive extraction and other methods of extraction commonly used like microwave assisted extraction, methods of fractionation. Separation of phytoconstituents by latest CCCET, SCFE techniques including preparative HPLC and Flash column chromatography.

4. Phytochemical finger printing: HPTLC and LCMS/GCMS -

   applications in the characterization of herbal extracts. Structure elucidation of phytoconstituents. **12 hrs**

5. Structure elucidation of the following compounds by spectroscopic techniques like UV, IR, MS, NMR (^{1}H, ^{13}C) **10 hrs**

a Carvone, Citral, Menthol

b Luteolin, Kaempferol

c Nicotine, Caffeine

d Glycyrrhizin

REFERENCES

1. Organic chemistry by I.L. Finar Vol.II
2. Pharmacognosy by Trease and Evans, ELBS.
3. Pharmacognosy by Tylor and Brady.
4. Text book of Pharmacognosy by Wallis.
5. Clark's isolation and Identification of drugs by A.C. Mottal.
6. Plant Drug Analysis by Wagner & Bladt.
7. Wilson and Gisvolds text book of Organic Medicinnal and Pharmaceutical Chemistry by Deorge. R.F.
8. The Chemistry of Natural Products, Edited by R.H. Thomson, Springer International Edn. 1994.
9. Natural Products Chemistry Practical Manual by Anees A Siddiqui and Seemi Siddiqui
10. Organic Chemistry of Natural Products, Vol. 1&2. Gurdeep R Chatwal.
11. Chemistry of Natural Products- Vol. 1 onwards IWPAC.
12. Modem Methods of Plant Analysis- Peach & M.V. Tracey, Vol. I&II
13. Medicinal Natural products – a biosynthetic approach, Dewick PM, John Wiley & Sons, Toronto, 1998.
14. Chemistry of Natural Products, Bhat SV, Nagasampagi BA, Meenakshi S, Narosa Publishing House, New Delhi.
15. Pharmacognosy & Phytochemistry of Medicinal Plants, 2nd edition, Bruneton J, Intercept Ltd., New York, 1999.

MPHARM – PHARMACOGNOSY (MPG)

SEMESTER I

PCO- MPG104T INDUSTRIAL PHARMACOGNOSTICAL TECHNOLOGY

COURSE CODE	**PCO- MPG104T**
COURSE TITLE	**INDUSTRIAL PHARMACOGNOSTICAL TECHNOLOGY** (Theory)

SCOPE/SUMMARY	**OBJECTIVES/COURSE OUTCOMES**
This course is designed to understand the industrial and commercial potential of drugs of natural origin, integrate traditional Indian system of medicine with modern medicine and also to know regulatory and quality policy for the trade of herbals and drugs from natural origin	At completion of this course it is expected that students will be able to understand- 1. The requirements for setting up the herbal drug industry 2. The guidelines for quality of natural drugs and regulatory issues 3. The use of monographs / Guidelines in accessing the quality of herbal products 4. The testing protocols for herbal medicines 5. The IPR of natural drugs and trade of raw and finished materials

Course Content and Assessment Plan

Sl. No.	**Course Content**	**Syllabus (Chapters or Units with hrs)**	**Total Marks of assessment**	**Distribution of Marks of Assessment**		
				Sessional exam (*30 % of total marks of assessment)*		**End Sem exam** (**7***0 % of total marks of assessment)*
				S1	**S2**	
1	Will know the concept herbal drug industry, herbal formulation and entrepreneurship development and various steps and skills involved in formulation and production management of herbals	Unit I (12 hrs)	24	08		16
2	Understand the basics of regulatory requirement for setting herbal industry ,concepts of TQM, EXIM,ISO 9000 series, GMP and GLP	Unit II (10 hrs)	20		07	13
3	Will study in detail the different monographs with traditional and herbal drugs and WHO guidelines to aces the quality of the herbal drugs	Unit III (12 hrs)	24		08	16

4	Will study in detail about various Quality testing, clinical lab testing and stability testing of natural products	Unit IV (10 hrs)	20	07		13
5	Will study in detail about Patenting /IPR of herbal/natural drugs and trade of raw and finished materials	Unit V (8 hrs)	17			17
Total Marks of Assessment			105	15	15	75

PCO- MPG104T INDUSTRIAL PHARMACOGNOSTICAL TECHNOLOGY

THEORY **52 hrs**

1. Herbal drug industry: Infrastructure of herbal drug industry involved in production of standardized extracts and various dosage forms. Current challenges in upgrading and modernization of herbal formulations. Entrepreneurship development, project selection, project report, technical knowledge, capital venture, plant design, layout and construction. Pilot plant scale – up techniques, case studies of herbal extracts. Formulation and production management of herbals. **12 hrs**

2. Regulatory requirements for setting herbal drug industry: Global marketing management. Indian and International patent law as applicable to herbal drugs and natural products. Export - Import (EXIM) policy, TRIPS. Quality assurance in herbal/natural drug products. Concepts of TQM, GMP, GLP, ISO-9000. **10 hrs**

3. Monographs of herbal drugs: General parameters of monographs of herbal drugs and comparative study in IP, USP, Ayurvedic Pharmacopoeia, Siddha and Unani Pharmacopoeia, American Herbal Pharmacopoeia, British Herbal Pharmacopoeia, WHO guidelines in quality assessment of herbal drugs. **12 hrs**

4. Testing of natural products and drugs: Herbal medicines - clinical laboratory testing. Stability testing of natural products and protocols. **10 hrs**

5. Patents: Indian and International patent laws, proposed amendments as applicable to herbal/natural products and process. Geographical indication, copyright, patentable subject maters, novelty, non-obviousness, utility, enablement and best mode, procedure for Indian patent filing, patent processing, grant of patents, rights of patents, cases of patents, opposition and revocation of patents, patent search and literature, controllers of patents. **08 hrs**

REFERENCES

1. Herbal Drug Industry by R.D. Choudhary (1996), Eastern Publisher, New Delhi.
2. GMP for Botanicals - Regulatory and Quality issues on Phytomedicine by Pulok K Mukharjee (2003), Ist Edition, Business horizons Robert Verpoorte, New Delhi.
3. Quality control of herbal drugs by Pulok K Mukarjee (2002), Business Horizons Pharmaceutical Publisher, New Delhi.
4. PDR for Herbal Medicines (2000), Medicinal Economic Company, New Jersey.
5. Indian Herbal Pharmacopoeia (2002), IDMA, Mumbai.
6. Text book of Pharmacognosy by C.K. Kokate, Purohit, Gokhale (1996), Nirali Prakashan, New Delhi.
7. Text book of Pharmacognosy and Phytochemistry by Vinod D. Rangari (2002), Part I & II, Career Publication, Nasik, India.
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11. Herbal Medicine. Expanded Commission E Monographs by M.Blumenthal, (2004), I Edition
12. Drug Formulation Manual by D.P.S.Kohli and D.H.Shah (1998), Eastern Publisher, New Delhi.

MPHARM – PHARMACOGNOSY(MPG)

SEMESTER I

PCO-MPG105P: PHARMACOGNOSY PRACTICAL I

COURSE CODE	PCO-MPG 105P
COURSE TITLE	PHARMACOGNOSY PRACTICAL – I (Practical)

SCOPE/SUMMARY	**OBJECTIVES/COURSE OUTCOMES**
The subject is designed to gain practical skills of various analytical / chromatographic techniques for phytoconstituents and herbal formulation. The subject helps the student to gain experience on various extraction techniques, identification of bioactive compounds and use of monographs in formulation and standardization of different dosage.	Upon completion of the course the student should be able to: 1. Gain the knowledge on various extraction, phytochemical screening methods for identification of phytoconstituents 2. Understand the various spectroscopic and chromatographic techniques for the analysis of crude drugs and phytoconstituents 3. Understand the effective use of monographs in standardization of herbal drugs and formulations

Course Content and Assessment Plan

Sl. No.	**Course Content**	**Syllabus (Chapters or Units with hours)**	**Total Marks of assessment**	**Distribution of Marks of Assessment**	
				Sessional exam (25 *% of total marks of assessment)*	**End Sem exam** (75 *% of total marks of assessment)*
				S1	
1	Will understand the use of various analytical techniques like UV-Visible spectrophotometer, Gas chromatography, Flame photometry and chromatographic methods in estimation and identification of various phytoconstituents in extracts/herbal formulation.	Expt 1-5and 8 (70 hrs)	58	14	44
2	Will gain experience on various extraction technique, phytochemical screening and identification of bioactive compounds in plant extracts	Expt 6,7,11 (30 hrs)	24	5	19
3	Understand the use of monographs in formulation and standardization of different dosage forms	Expt 9-12 (56 hrs)	48	11	37
		Total Marks of Assessment	130	30	100

PCO-MPG105P: PHARMACOGNOSY PRACTICAL I

1. Analysis of Pharmacopoeial compounds of natural origin and their formulations by UV-Vis spectrophotometer
2. Analysis of recorded spectra of simple phytoconstituents
3. Experiments based on Gas Chromatography
4. Estimation of sodium/potassium by flame photometry
5. Development of fingerprint of selected medicinal plant extracts commonly used in herbal drug industry *viz.* Ashwagandha, Tulsi, Bael, Amla, Ginger, Aloe, Vidang, Senna, Lawsonia by TLC/HPTLC method.
6. Methods of extraction.
7. Phytochemical screening.
8. Demonstration of HPLC- estimation of glycyrrhizin.
9. Monograph analysis of Clove oil.
10. Monograph analysis of Castor oil.
11. Identification of bioactive constituents from plant extracts.
12. Formulation of different dosage forms and their standardization.

REFERENCES

1. Harborne AJ. Phytochemical methods a guide to modern techniques of plant analysis. springer science & business media; 1998 Apr 30.
2. Bolliger HR, Brenner M, Gänshirt H, Mangold HK, Seiler H, Stahl E, Waldi D. Thin-layer chromatography: a laboratory handbook. Springer-Verlag; 1965.
3. Kr Khandelwal. Practical Pharmacognosy techniques and experiments. Nirali Prakashan, Pune. 2005; 13:144-55.
4. Gokhale MS, Kokate CK. Practical pharmacognosy. Editora Record; 2008 Aug 7.
5. Indian Herbal Pharmacopoeia. Indian drug manufacturers' Association. Revised ed. 2002.
6. WHO monographs on selected medicinal plants. – Geneva: WHO. – Vol. 1. 1999, – Vol. 2. 2002, – Vol. 3: 2004, – Vol. 4. 2005.
7. Quality Standards of Indian Medicinal Plants – Indian Council of Medical Research, New Delhi.
8. Indian Herbal Pharmacopoeia – A Joint Publication of RRL, Jammu and IDMA, Mumbai.
9. Ayurvedic Pharmacopoeia of India, Ministry of AYUSH, Government of India.

MPHARM – PHARMACOGNOSY (MPG)
SEMESTER I

PCO-MPG 106S: SEMINAR IN PHARMACOGNOSY

COURSE CODE	PCO- MPG 106S
COURSE TITLE	SEMINAR IN PHARMACOGNOSY

SCOPE/SUMMARY	**OBJECTIVES/COURSE OUTCOMES**
The subject is designed to create an environment where teachers provide the students a critical eye and openness to fortify the presentation and academic writing skills of students in the field of herbal drugs/Research	Upon completion of the course the student shall be able to: 1. Develop skills to gather, organize, deliver information, and defend a given topic in herbal research. 2. Learn to utilize audio-visual aids for effective deliverance of the topic. 3. Acquire communication and presentation skills. 4. Effectively respond to the questions raised by peers and stand scientific scrutiny. 5. Develop a write-up on the subject of seminar presentation. 6. Cultivate a sense of upgradation of knowledge through self and continuous learning

Course Content and Assessment Plan

Sl. No.	**Course Content**	**Hours**	**Total Marks of assessment**	**Marks**
				End Sem exam
1	The students should be able to develop skills to gather, organize, deliver information, and defend a given topic in herbal drugs/Research	2 hrs/week	100	No end-semester examination. Only continuous mode.

MPHARM – PHARMACOGNOSY (MPG)

SEMESTER II

PCO-MPG201T: MEDICINAL PLANT BIOTECHNOLOGY

COURSE CODE	PCO- MPG201T
COURSE TITLE	MEDICINAL PLANT BIOTECHNOLOGY (Theoory)

SCOPE/SUMMARY	**OBJECTIVES/COURSE OUTCOMES**
To explore the knowledge of Biotechnology and its application in the improvement of quality of medicinal plants	Upon completion of the course, the student shall be able to 1. Understand development of plant biotechnology and its application in pharmacy 2. Gain the knowledge in different tissue culture techniques in depth 3. Understand the biotechnological techniques for obtaining and improving the quality of natural products. 4. Know the process like genetic engineering in medicinal plants for higher yield of phytopharmaceuticals. 5. Understand fermentation technology and their applications in pharmacy

Course Content and Assessment Plan

Sl. No.	**Course Content**	**Syllabus (Chapters or Units with hrs)**	**Total Marks of assessment**	**Distribution of Marks of Assessment**		
				Sessional exam (*30 % of total marks of assessment)*		**End Sem exam** (*70 % of total marks of assessment)*
				S1	**S2**	
1	Will learn introductory aspects of biotechnology including history, development and applications in pharmacy	Unit I (10 hrs)	20	07		13
2	Will gain the knowledge in different tissue culture techniques and their applications	Unit II (12 hrs)	25	08		17
3	Will study immobilization techniques of plant cell and its applications in secondary metabolite production	Unit III (12 hrs)	24		07	17
4	Will learn biotransformation, transgenesis and applications of PCR in plant genome analysis.	Unit IV (13 hrs)	26		08	18
5	Shall understand fermentation technology and their applications in pharmacy	Unit V (5 hrs)	10			10
		Total Marks of Assessment	105	15	15	75

PCO-MPG201T: MEDICINAL PLANT BIOTECHNOLOGY

THEORY **52 hrs**

1. Introduction to plant biotechnology: Historical perspectives, prospects for development of plant biotechnology as a source of medicinal agents. Applications in pharmacy and allied fields. Genetic and molecular biology as applied to pharmacognosy, study of DNA, RNA and protein replication, genetic code, regulation of gene expression, structure and complicity of genome, cell signaling, DNA recombinant technology. **10 hrs**
2. Different tissue culture techniques: Organogenesis and embryogenesis, synthetic seed and monoclonal variation, protoplast fusion, hairy root, multiple shoot cultures and their applications. Micro propagation of medicinal and aromatic plants. Sterilization methods involved in tissue culture, gene transfer in plants and their applications. **12hrs**
3. Immobilisation techniques and secondary metabolite production: Immobilization techniques of plant cell and its application on secondary metabolite production. Cloning of plant cell - different methods of cloning and its applications. Advantages and disadvantages of plant cell cloning. Secondary metabolism in tissue cultures with emphasis on production of medicinal agents. Precursors and elicitors on production of secondary metabolites. **12 hrs**
4. Biotransformation and Transgenesis: Biotransformation, bioreactors for pilot and large scale cultures of plant cells and retention of biosynthetic potential in cell culture. Transgenic plants, methods used in gene identification, localization and sequencing of genes. Application of PCR in plant genome analysis. **13 hrs**
5. Fermentation technology: Application of Fermentation technology, production of ergot alkaloids, single cell proteins, enzymes of pharmaceutical interest. **05 hrs**

REFERENCES

1. Plant tissue culture, Bhagwani, vol 5, Elsevier Publishers.
2. Plant cell and Tissue Culture (Lab. Manual), JRMM. Yeoman.
3. Elements in Biotechnology by PK. Gupta, Rastogi Publications, New Delhi.
4. An Introduction to Plant Tissue Culture by MK. Razdan, Science Publishers.
5. Experiments in Plant Tissue Culture by John HD and Lorin WR., Cambridge University Press.
6. Pharmaceutical Biotechnology by SP. Vyas and VK. Dixit, CBS Publishers.
7. Plant Cell and Tissue Culture by Jeffrey W. Pollard and John M Walker, Humana press.

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9. Plant Tissue Culture by Street.
10. Pharmacognosy by G. E. Trease and WC. Evans, Elsevier.
11. Biotechnology by Purohit and Mathur, Agro-Bio, 3rd revised edition.
12. Biotechnological Applications to Tissue Culture by Shargool, Peter D, Shargoal, CKC Press.
13. Pharmacognosy by Varo E. Tyler, Lynn R. Brady and James E. Robberrt, That Tjen, NGO.
14. Plant Biotechnology by Ciddi Veerasham.

MPHARM – PHARMACOGNOSY (MPG)

SEMESTER II

PCO-MPG 202T: ADVANCED PHARMACOGNOSY II

COURSE CODE	PCO-MPG202T
COURSE TITLE	ADVANCED PHARMACOGNOSY II (Theory)

SCOPE/SUMMARY	**OBJECTIVES/COURSE OUTCOMES**
The course is designed to impart to know and understand the adulteration and deterioration that occurs in herbal/ natural drugs and methods of the detection of the same. Study of herbal remedies and their validations, including methods of screening	Upon completion of this course the student shall be able to 1. Know the validation of herbal remedies 2. Know the methods of detection of adulteration, evaluation technique for the herbal drugs 3. Understand the role of ethnobotany and ethno pharmacology in drug discovery. 4. Gain knowledge on various analytical profile for herbal drugs 5. Gain knowledge on methods of screening of herbals for various biological properties

Course Content and Assessment Plan

Sl. No.	**Course Content**	**Syllabus (Chapters or Units with hours)**	**Total Marks of assessment**	**Distribution of Marks of Assessment**		
				Sessional exam (30 *% of total marks of assessment)*		**End Sem exam** (70 *% of total marks of assessment)*
				S1	**S2**	
1	Shall gain knowledge regarding herbal remedies, toxicity regulations, pharmacodynamics and pharmacokinetic issues.	Unit I (10 hrs)	20	7		13
2	Understand and learn adulteration, deterioration and detection aspects of crude drug including its quality control studies as per WHO	Unit II (10 hrs)	20			20
3	Learn the aspects of ethnobotany, ethnopharmacology, bioprospecting tools including reverse pharmacology process for drug discovery and development	Unit III (10 hrs)	20	8		12

4	Learn the various analytical profiles of herbal drugs	Unit IV (12 hrs)	25		7	18
5	Will learn various in vitro and in vivo screening techniques for various disease models.	Unit V (10 hrs)	20		8	12
Total Marks of Assessment			105	15	15	75

MPG 202T: ADVANCED PHARMACOGNOSY II

THEORY **52 hrs**

1. Herbal remedies – Toxicity and Regulations: Herbals vs conventional drugs, efficacy of herbal medicine products, and validation of herbal therapies, pharmacodynamic and pharmacokinetic issues. **10 hrs**

2 Adulteration and deterioration: Introduction, types of adulteration/substitution of herbal drugs, causes and measures of adulteration, sampling procedures, determination of foreign matter, DNA finger printing techniques in identification of drugs of natural origin, detection of heavy metals, pesticide residues, phytotoxin, microbial contamination in herbs and their formulations. **10 hrs**

3 Ethnobotany and Ethnopharmacology: Ethnobotany in herbal drug evaluation, impact of ethnobotany in traditional medicine, new development in herbals, bio-prospecting tools for drug discovery, role of ethnopharmacology in drug evaluation, reverse pharmacology. **10 hrs**

4 Analytical profiles of herbal drugs: *Andrographis paniculata, Boswellia serrata, Coleus forskholii, Curcuma longa, Emblica officinalis, Psoralea corylifolia.* **12 hrs**

5 Biological screening of herbal drugs: Introduction and need for phyto-pharmacological screening, new strategies for evaluating natural products, *In vitro* evaluation techniques for antioxidants, antimicrobial and anticancer drugs. *In vivo* evaluation techniques for anti-inflammatory, antiulcer, anticancer, wound healing, antidiabetic, hepatoprotective, cardio protective, diuretics and antifertility, toxicity studies as per OECD guidelines. **10hrs**

REFERENCES

1. Glimpses of Indian Ethano Pharmacology by P. Pushpangadam. Ulf Nyman. V.George Tropical Botanic Garden & Research Institute.
2. Natural products: A lab guide by Raphael Ikan, Academic Press.
3. Pharmacognosy - G. E. Trease and W.C. Evans. WB. Saunders Edinburgh, New York.
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5. Modem Methods of Plant Analysis- Peach & M.V. Tracey, Vol. I & II, Springer Publishers.
6. Herbal Drug Industry by RD. Choudhary, Eastern Publishers, New Delhi.
7. Text book of Pharmacognosy by C.K.Kokate, Purohit, Ghokhale, Nirali Prakashan.
8. Text Book of Pharmacognosy by T.E. Wallis, J & A Churchill Ltd., London.
9. Quality control of herbal drugs by Pulok K Mukherjee, Business Horizons Pharmaceutical Publishers, New Delhi.
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11. Text book of Pharmacognosy and Phytochemistry by Vinod D. RangarI, Part I & II, Career Publication, Nasik, India.
12. Plant drug analysis by H.Wagner and S.Bladt, 2nd edition, Springer, Berlin.
13. Standardization of Botanicals. Testing and extraction methods of medicinal herbs by V. Rajpal (2004), Vol. I, Eastern Publishers, New Delhi.
14. Herbal Medicine. Expanded Commission E Monographs, M. Blumenthal.

MPHARM – PHARMACOGNOSY (MPG)

SEMESTER II

PCO- MPG203T INDIAN SYSTEMS OF MEDICINE

COURSE CODE	PCO-MPG203T
COURSE TITLE	INDIAN SYSTEMS OF MEDICINE (Theory)

SCOPE/SUMMARY	**OBJECTIVES/COURSE OUTCOMES**
The course is designed to understand thoroughly the principles, preparations of medicines of various ISM. Also focusing on clinical research of traditional medicines, QA and challenges in monitoring the safety of herbal medicines.	After the completion of the course the students will be able to understand the 1. Basic principles of various Indian Systems of Medicine. 2. Importance of Naturopathy, Yoga and Aromatherapy in health care system 3. Preparation and standardization of various AYUSH formulations. 4. Regulatory guidelines in setting herbal industry. 5. TKDL and government bills involved in providing education and research in AYUSH systems.

Course Content and Assessment Plan

Sl. No.	**Course Content**	**Syllabus (Chapters or Units with hours)**	**Total Marks of assessment**	**Distribution of Marks of Assessment**		
				Sessional exam (30 *% of total marks of assessment)*		**End Sem exam** (**7***0 % of total marks of assessment)*
				S1	**S2**	
1	Will gain the knowledge regarding the fundamental concepts of AYUSH systems of medicine and their different dosage forms.	Unit I (10 hrs)	20	7		13
2	Will understand the various types of therapy such as Naturopathy, Yoga and Aromatherapy.	Unit II (10hrs)	20	8		12
3	Will study in detail the formulation development of various systems of medicine including salient features of various formulations of ISM and Standardization, shelf-life and stability studies of ISM formulations.	Unit III (12 hrs)	25		8	17

4	Will study in detail regarding Schedule T-GMP of ISM and about QA of ISM and also challenges in monitoring the safety of herbal medicines.	Unit IV (10 hrs)	20		7	13
5	Will study in detail about TKDL, Geographical indication Bill and Government bills in AYUSH and other Councils of AYUSH.	Unit V (10 hrs)	20			20
Total Marks of Assessment			105	15	15	75

PCO- MPG203T INDIAN SYSTEMS OF MEDICINE

THEORY **52 hrs**

1. Fundamental concepts of Ayurveda, Siddha, Unani and Homoeopathy systems of medicine. Different dosage forms of the ISM. Ayurveda:

   Ayurvedic Pharmacopoeia, analysis of formulations and bio crude drugs with references to identity, purity and quality.

   Siddha: Gunapadam (Siddha Pharmacology), raw drugs/Dhatu/Jeevam in Siddha system of medicine, purification process (Shuddhi). **10 hrs**
2. Naturopathy, Yoga and Aromatherapy practices

a) Naturopathy - Introduction, basic principles and treatment modalities.

b) Yoga - Introduction and Streams of Yoga. Asanas, Pranayama, Meditations and relaxation techniques.

c) Aromatherapy – Introduction, aroma oils for common problems, carrier oils. **10 hrs**

3. Formulation development of various systems of medicine. Salient features of the techniques of preparation of some of the important class of formulations as per Ayurveda, Siddha, Homeopathy and Unani Pharmacopoeia and texts. Standardization, shelf life and stability studies of ISM formulations. **12 hrs**
4. Schedule T – Good Manufacturing Practice of Indian systems of medicine Components of GMP (Schedule - T) and its objectives, infrastructural requirements, working space, storage area, machinery and equipment's, standard operating procedures, health and hygiene, documentation and records.

   Quality assurance in ISM formulation industry - GAP, GMP and GLP. Preparation of documents for new drug application and export registration.

Challenges in monitoring the safety of herbal medicines: Regulation, quality assurance and control, National/Regional Pharmacopoeias. **10 hrs**

5. TKDL, Geographical indication Bill, Government bills in AYUSH, ISM, CCRAS, CCRS, CCRH, CCRU **10 hrs**

REFERENCES

1. Ayurvedic Pharmacopoeia, The Controller of Publications, Civil Lines, Govt. of India, New Delhi.
2. Hand Book on Ayurvedic Medicines, H. Panda, National Institute of Industrial Research, New Delhi.
3. Ayurvedic System of Medicine, Kaviraj Nagendranath Sengupata, Sri Satguru Publications, New Delhi.
4. Ayurvedic Pharmacopoeia. Formulary of Ayurvedic Medicines, IMCOPS, Chennai.
5. Homeopathic Pharmacopoeia. Formulary of Homeopathic Medicines, IMCOPS, Chennai.
6. Homeopathic Pharmacy: An introduction & Hand book, Steven B. Kayne, Churchill Livingstone, New York.
7. Indian Herbal Pharmacopoeia, IDMA, Mumbai.
8. British Herbal Pharmacopoeia, BRITISH Herbal Medicine Association, UK.
9. GMP for Botanicals - Regulatory and Quality issues on Phytomedicine, Pulok K Mukharjee, Business Horizons, New Delhi.
10. Indian System of Medicine and Homeopathy in India, Planning and Evaluation Cell, Govt. of India, New Delhi.
11. Essential of Food and Nutrition, Swaminathan, Bappco, Bangalore.
12. Clinical Dietitics and Nutrition, F.P. Antia, Oxford University Press, Delhi.
13. Yoga - The Science of Holistic Living by V.K.Yoga, Vivekananda Yoga Prakashna Publishing, Bangalore.

MPHARM – PHARMACOGNOSY (MPG)

SEMESTER II

PCO-MPG 204T: HERBAL COSMETICS

COURSE CODE	PCO- MPG 204T
COURSE TITLE	**MPG 204T: HERBAL COSMETICS** (THEORY)

SCOPE/SUMMARY	**OBJECTIVES/COURSE OUTCOMES**
The course is designed to understand the study of preparation and standardizations of herbal/natural cosmetics. This subject gives emphasis to various national and international standards prescribed regarding herbal cosmeceuticals	After completion of the course the students will be able to understand the 1. Economic aspects and Regulatory provisions relation to manufacture of cosmetics 2. Various raw material, additives, compatibility studies and interactions between chemicals and herbs in the cosmetic formulations 3. Physiology of skin, lips, nails, hairs and preparation of various herbal cosmetics and its standardization. 4. Various cosmeceuticals of natural origin and its applications 5. Various toxicity screening and quality control studies for cosmetics as per D & C Act.

Course Content and Assessment Plan

Sl. No.	**Course Contents**	**Syllabus (Chapters or Units with hours)**	**Total Marks of assessment**	**Distribution of Marks of Assessment**		
				Sessional exam (30 *% of total marks of assessment)*		**End Sem exam** (**7***0 % of total marks of assessment)*
				S1	**S2**	
1	Will gain the knowledge regarding requirement of regulatory standards, offenses and penalties, import/export policies and industries involved in the production of herbal /natural cosmetics	Unit I (10 hrs)	20	7		13
2	Will understand the various raw material and additives, required in the cosmetic formulation, its compatibility studies and herb – chemical interaction in herbal formulation.	Unit II (10 hrs)	20	8		12
3	Will study in detail the physiology and chemistry of	Unit III (10 hrs)	21		7	14

	skin, lips, nails, hairs and various herbal cosmetics preparation and standardization used for the same.					
4	Will study in detail regarding various herbs and their formulation used in hair growth and skin care products	Unit IV (12 hrs)	24		8	16
5	Will study in detail about screening methods, analysis, quality control and toxicity studies of herbal cosmetics as per D&C Act.	Unit V (10 hrs)	20			20
Total Marks of Assessment			105	15	15	75

MPG 204T: HERBAL COSMETICS

THEORY **52 hrs**

1. Introduction: Herbal/natural cosmetics, Classification & Economic aspects. Regulatory provisions relation to manufacture of cosmetics: License, GMP, offences & penalties, import & export of herbal/natural cosmetics, industries involved in the production of herbal/natural cosmetics. **10 hrs**
2. Commonly used herbal cosmetics: raw materials, preservatives, surfactants, humectants, oils, colors, and some functional herbs, preformulation studies, compatibility studies, possible interactions between chemicals and herbs, design of herbal cosmetic formulation. **10 hrs**
3. Herbal Cosmetics: Physiology and chemistry of skin and pigmentation, hairs, scalp, lips and nail, cleansing cream, lotions, face powders, face packs, lipsticks, bath products, soaps and baby product, preparation and standardization of the following: Tonic, Bleaches, Dentifrices, Mouth washes & Tooth pastes, and Cosmetics for nails. **10 hrs**
4. Cosmeceuticals of herbal and natural origin: Hair growth formulations, shampoos, conditioners, colorants & hair oils, fairness formulations, vanishing & foundation creams, anti-sun burn preparations, moisturizing creams and deodorants. **12 hrs**
5. Analysis of cosmetics, toxicity screening and test methods, Quality control and toxicity studies as per D & C Act. **10 hrs**

REFERENCES

1. Panda H. Herbal Cosmetics (Hand book), Asia Pacific Business Press Inc, New Delhi.
2. Thomson EG. Modern Cosmetics, Universal Publishing Corporation, Mumbai.
3. P.P.Sharma. Cosmetics - Formulation, Manufacturing & Quality Control, Vandana Publications, New Delhi.
4. Supriya K B. Handbook of Aromatic Plants, Pointer Publishers, Jaipur.
5. Skaria P. Aromatic Plants (Horticulture Science Series), New India Publishing Agency, New Delhi.
6. Kathi Keville and Mindy Green. Aromatheraphy (A Complete Guide to the Healing Art), Sri Satguru Publications, New Delhi
7. Chattopadhyay PK. Herbal Cosmetics & Ayurvedic Medicines (EOU), National Institute of Industrial Research, Delhi.
8. Balsam MS & Edward Sagarin. Cosmetics Science and Technology, Wiley Interscience, New York.

MPHARM – PHARMACOGNOSY (MPG)

SEMESTER II

PCO-MPG205P: PHARMACOGNOSY PRACTICAL II

COURSE CODE	PCO-MPG 205P
COURSE TITLE	PHARMACOGNOSY PRACTICAL – II

SCOPE/SUMMARY	**OBJECTIVES/COURSE OUTCOMES**
The subject is designed to gain practical skills on estimation and establishment of various plant biotechnology techniques and estimation of various secondry metabolites in herbal raw materials. The subject helps the students to learn to formulate and standardize various AYUSH and cosmetic preparations for the intended use.	Upon completion of the course the student should be able to 1. Demonstrate the practical skills in establishment of various plant tissue culture techniques. 2. Gain experience on estimation of various secondary plant metabolites 3. Gain the knowledge to formulate and standardize various AYUSH and cosmetic preparations for the intended use.

Course Content and Assessment Plan

Sl. No.	**Course Content**	**Syllabus (Chapters or Experiments with hours)**	**Total Marks of assessment**	**Distribution of Marks of Assessment**	
				Sessional exam (25 *% of total marks of assessment)*	**End Sem exam** (**75** *% of total marks of assessment)*
				S1	
1	Will gain the skills on estimation and establishment of various plant biotechnology techniques	Experiments 1 to 6 (30 hrs)	25	5	20
2	Will gain the hands on experience on estimation of various secondary metabolites such as aldehydes, alkaloids, phenols and flavonoids in herbal raw materials	Experiments 7 to10 (50 hrs)	40	10	30
3	Will gain the knowledge to formulate and standardize various AYUSH and cosmetic preparations such as tablets, syrups, aromatherapy formulations, skin, hair and nail care products for the intended use.	Experiments 11 to 16 (76 hrs)	65	15	50
		Total Marks of Assessment	130	30	100

PCO-MPG205P: PHARMACOGNOSY PRACTICAL II

1. Isolation of nucleic acid from cauliflower heads
2. Isolation of RNA from yeast
3. Quantitative estimation of DNA
4. Immobilization technique
5. Establishment of callus culture
6. Establishment of suspension culture
7. Estimation of aldehyde contents of volatile oils
8. Estimation of total phenolic content in herbal raw materials
9. Estimation of total alkaloid content in herbal raw materials
10. Estimation of total flavonoid content in herbal raw materials
11. Preparation and standardization of various simple dosage forms from Ayurvedic, Siddha, Homoeopathy and Unani formulary
12. Preparation of certain Aromatherapy formulations
13. Preparation of herbal cosmetic formulation such as lip balm, lipstick, facial cream, herbal hair and nail care products
14. Evaluation of herbal tablets and capsules
15. Preparation of sunscreen, UV protection cream, skin care formulations.
16. Formulation & standardization of herbal cough syrup.

REFERENCES

1. Experiments in Plant Tissue Culture by John HD and Lorin WR., Cambridge University Press.
2. Pharmaceutical Biotechnology by SP. Vyas and VK. Dixit, CBS Publishers.
3. Plant Cell and Tissue Culture by Jeffrey W. Pollard and John M Walker, Humana press.
4. Plant Tissue Culture by Dixon, Oxford Press, Washington DC, 1985
5. Plant Biotechnology by Ciddi Veerasham.
6. Ayurvedic Pharmacopoeia of India, Ministry of AYUSH, Government of India.
7. Textbook of cosmetics Rajesh Kumar Nema, Kamal Singh Rathore, Bal Krishna Dubey, CBS Publishers and distributors, First edition 2009 New Delhi.
8. Cooper and Guns, Dispensing for Pharmaceutical students, S.J.Karter 12th Edition CBS Publishers and distributors, First edition 2009 New Delhi.

9. Introduction to cosmetic formulation and technology, Gabriella Baki and Kenneth S Allexander, John Wiley and sons, Inc, New Jersey
10. Harry's Cosmeticology, Volumes I-II (8th Edition)
11. Lachman Liebermans, The Theory and Practice of Industrial Pharmacy 4Ed
12. Indian Pharmacopoeia, Government of India Ministry of Health and Family welfare, published by The Indian Pharmacopoeia commission India.

MPHARM – PHARMACOGNOSY (MPG)

SEMESTER II

PCO-MPG206S: SEMINAR IN PHARMACOGNOSY

COURSE CODE	PCO- MPG 206S
COURSE TITLE	SEMINAR IN PHARMACOGNOSY

SCOPE/SUMMARY	**OBJECTIVES/COURSE OUTCOMES**
The subject is designed to create an environment where teachers provide the students a critical eye and openness to fortify the presentation and academic writing skills of students in the field of herbal drugs/Research	Upon completion of the course the student shall be able to: 1. Develop skills to gather, organize, deliver information, and defend a given topic in Herbal drug research. 2. Learn to utilize audio-visual aids for effective deliverance of the topic. 3. Acquire communication and presentation skills. 4. Effectively respond to the questions raised by peers and stand scientific scrutiny. 5. Develop a write-up on the subject of seminar presentation. 6. Cultivate a sense of upgradation of knowledge through self and continuous learning

Course Content and Assessment Plan

Sl. No.	**Course Content**	**Hours**	**Total Marks of Assessment**	**Marks**
				End Sem exam
1	The students should be able to develop skills to gather, organize, deliver information, and defend a given topic in herbal drugs/Research	2 hrs/week	100	No end-semester examination. Only continuous mode.

MPHARM – PHARMACOGNOSY (MPG)

SEMESTER III

PHA-MRM301T: RESEARCH METHODOLOGY AND BIOSTATISTICS

COURSE CODE	PHA-MRM301T
COURSE TITLE	RESEARCH METHODOLOGY AND BIOSTATISTICS (Theory)

SCOPE / SUMMARY	**OBJECTIVES / COURSE OUTCOMES**
This subject is designed to understand the advanced knowledge for research methodology, ethics in research, medical research, design, conduct and interpretation of results. This subject deals with descriptive statistics principles and their applications in biostatistics involving parametric tests, non-parametric tests, correlation, regression, probability theory and statistical hypotheses.	Upon completion of the course the student shall be able to 1. Know the various components of research design and methodology. 2. Appreciate advanced statistical techniques in solving the research problems.

Course Content and Assessment Plan

Sl. No.	**Course Content**	**Syllabus (Chapters or Units with hours)**	**Total Marks of assessment**	**Distribution of Marks of Assessment**		
				Sessional exam (*80 % of total marks of assessment)*		**End Sem exam**
				S1	**S2**	
1	Understand the General Research Methodology, and study design.	Unit I (10 hrs)	20	20		-
2	Study the statistical principles and their application in biostatistics. Besides, learning various techniques of biostatistics to interpret the study outcomes.	Unit II (12 hrs)	20	20		-
3	Learn the CPCSEA guidelines, records and SOPs related to handling and care of experimental animals.	Unit III (10 hrs)	10		10	-
4	Student will learn the history, principles, and concepts of medical research.	Unit IV (10 hrs)	20		20	-
5	Learn history, basic principles for all medical research and additional principles for medical research combined with medical care.	Unit V (10 hrs)	10		10	-
		Total Marks of Assessment	80	40	40	-

PHA-MRM301T: RESEARCH METHODOLOGY AND BIOSTATISTICS

THEORY **52 hrs**

UNIT – I

General Research Methodology: Research objectives, requirements, practical difficulties, review of literature, study design, types of studies, strategies to eliminate errors/bias, controls, randomization, crossover design, placebo, blinding techniques.

UNIT – II

Biostatistics: Definition, application, sample size, importance of sample size, factors influencing sample size, dropouts, statistical tests of significance, null hypothesis, P values, degree of freedom, interpretation of P values. Type of significance tests, parametric tests (students "t" test, ANOVA, Correlation coefficient, regression), non-parametric tests (Wilcoxon rank tests, analysis of variance, correlation, chi square test),

UNIT – III

CPCSEA guidelines for laboratory animal facility: Goals, veterinary care, quarantine, surveillance, diagnosis, treatment and control of disease, personal hygiene, location of animal facilities and laboratories, anesthesia, euthanasia, physical facilities, environment, animal husbandry, record keeping, SOPs, personnel and training, transport of lab animals.

UNIT – IV

Medical Research: History, values in medical ethics, autonomy, beneficence, non-maleficence, double effect, conflicts between autonomy and beneficence/non-maleficence, euthanasia, informed consent, confidentiality, criticisms of orthodox medical ethics, importance of communication, control resolution guidelines, ethics committees, cultural concerns, truth telling, online business practices, conflicts of interest, referral, vendor relationships, treatment of family members, sexual relationships fatality.

UNIT – V

Declaration of Helsinki: History, introduction, basic principles for all medical research and additional principles for medical research combined with medical care.

MPHARM – PHARMACOGNOSY (MPG)

SEMESTER III

MJC 302P: JOURNAL CLUB IN PHARMACOGNOSY

COURSE CODE	MJC302P
COURSE TITLE	JOURNAL CLUB IN PHARMACOGNOSY

SCOPE/SUMMARY	**OBJECTIVES/COURSE OUTCOMES**
The subject is designed to create an environment where students present a published research paper, and critically analyze it, that would enhance the communication, presentation and analytical skills of the students.	Upon completion of the course the student shall be able to: 1. Learn to organize complex research concepts using audio-visual aids. 2. Acquire communication and presentation skills. 3. Effectively respond to the questions raised by peers and stand scientific scrutiny. 4. Cultivate a sense of upgradation of knowledge through self and continuous learning

Course Content and Assessment Plan

Sl. No.	**Course Content**	**Hours**	**Total Marks of assessment**	**Marks**
				End Sem exam
1	The students should be able to develop skills to gather, organize, deliver information, and defend a given research topic in pharmacognosy.	2 hrs/week	100	No end-semester examination. Only continuous mode.

MPHARM – CHOICE BASED INTERDISCIPLINARY COURSES

PCE-001E: GENERIC DRUG DEVELOPMENT

(15 hrs)

Introduction to Generic Drug Product Development, API, Analytical Methods Development and Methods Validation for Solid Oral Dosage Forms, Experimental formulation development, Scale-Up, Process Validation, Technology Transfer, Drug stability, QC, QA. Drug product performance in vitro, ANDA Regulatory approval process, BE and drug product assessment in vivo, SUPAC, Outsourcing BA and BE studies to CROs, Legal and legislative hurdles.

REFERENCES

1. Handbook of Pharmaceutical Generic Development, (oral dosage form volume 24 of Drug development series), Locum publishing house, USA.
2. Generic Drug Product Development-Solid Oral dosage form, Leon Shargel and Isadore Kanfer, Marcel Dekker, USA, ISBN: 0-8247-5460-3.

PCE-002E: PHARMACEUTICAL DISSOLUTION TECHNOLOGY

(15 hrs)

Introduction and importance of dissolution. Different Pharmacopoeial requirements (Ph. Eu. JP) on dissolution.	**2 hrs**
Theories of dissolution. Noyes & Whitney equation and Hixson & Crowell Cube root.	**2 hrs**
Compendial methods and official dissolution test apparatus.	**2 hrs**
Principles, concepts and requirements of new dissolution method developments.	**2 hrs**
Alternative methods for drug release studies.	**1 hr**
Recommended apparatus for drug release studies of suppositories, topical, transdermal, powder dosage forms, controlled release products, etc.	**1 hr**
Computation of dissolution data with statistical approaches, model dependent approaches and model independent approaches.	**2 hrs**
Development of IVIVC models.	**1 hr**
Brief account on Biosimilar, Biowaiver, ICH Q4B and new regulatory prospective in dissolution.	**2 hrs**

REFERENCES

1. Pharmaceutical Dissolution Testing by Umesh V. Banakar; Singapore: CRC Press – Taylor & Francis Group.
2. Pharmaceutical Dissolution Testing by Jennifer Dressman and Johannes Krämer; Singapore: Taylor & Francis Group.

PCE-003E: PARTICULATE DRUG DELIVERY SYSTEMS

(15 hrs)

Microparticulate drug delivery Systems: Introduction, advantages, disadvantages, types, methods of preparation & characterization, in vitro & in vivo evaluations and applications.

6 hrs

Nanoparticulate drug delivery Systems: Introduction, advantages, disadvantages, types, methods of preparation & characterization, in vitro & in vivo evaluations and applications.

9 hrs

REFERENCES

1. Encyclopedia of controlled delivery, Editor- Edith Mathiowitz, Published by Wiley Interscience Publication, John Wiley and Sons, Inc, New York. Chichester/Weinheim
2. N.K. Jain, Controlled and Novel Drug Delivery, CBS Publishers & Distributors, New Delhi, First edition 1997 (reprint in 2001)
3. S.P.Vyas and R.K.Khar, Controlled Drug Delivery - concepts and advances, Vallabh Prakashan, New Delhi, First edition 2002
4. Nanoteachnology in Drug Delivery, Melgardt M. De Villers, Pornanong Aramwit and Glen S Kwon, Springer.
5. Nanoparticulate Drug Delivery Systems, Deepak Thassu, Michel Delees and Yashwant Pathak, Informa Healthcare, NY, USA.
6. Nanoparticulates as Drug Carriers, Vladimir P Torchilin, Imperial College Press, London.

PCE-004E: 3D PRINTING IN PHARMACEUTICAL MANUFACTURING

(15 hrs)

Introduction, 3D printing technologies, printing based inkjet systems, Nozzle based deposition systems, Laser based writing systems, 3D printing for customized drug delivery systems, Limitations and challenges.

REFERENCES

1. 3D printing in pharmaceutics: A new tool for designing customized drug delivery systems. Goole Jonathan and Amighi Karim, Int. J Pharm. 499 (2016), 376-394.
2. 3D fabricated polymer-based drug delivery systems, Simon Moulton and Gordon G Wallace, J of Cont. Rel. 193 (2014), 27-34.
3. Fabrication of printed drug delivery systems. Natalja Genina, Ruzica Kolakovic, Mirja Palo, Daniela Fors, Helka Juvonen, Petri Ihalainen, Jouko Peltonen, Niklas Sandler, NIP 29 and Digital Fabrication (2013), 236-238.

PCH-001E: PREPARATIVE SEPARATION TECHNIQUES

(15 hrs)

1. Column chromatography: Introduction, stationary phase, mobile phase selection, column selection, sample loading techniques, elution technique. **9 hrs**
2. Flash chromatography: Principle, advantages, instrumentation, mobile phase selection, column selection, sample loading techniques, elution technique. **6 hrs**

PCH-002E: MOLECULAR MODELLING AND DRUG DESIGN

(15 hrs)

1. Molecular Geometry, Molecular mechanics, Quantum mechanics, Molecular dynamics, Pharmcophore, Molecular docking, Library generation and structure-based drug design. **12 hrs**
2. Database and Software Resources **3 hrs**

PCH-003E: HYPHENATED TECHNIQUES

(15 hrs)

Principle and applications of following hyphenated techniques

1. GC-MS	4. EC-MS	7. LC-MS-MS	10. GC-AES
2. LC-MS	5. CE-MS	8. GC-MS-MS	
3. LC-NMR	6. GC-IR	9. GC-NMR	

PCH-004E: CHEMICALS-ENVIRONMENT, HEALTH AND SAFETY

(15 hrs)

Chemical safety, Chemical hazards, handling of chemicals/gases, storage of chemicals, chemical waste disposal. **8 hrs**

First aid procedures **1 hr**

Good laboratory practices: **2 hrs**

Personal protection **1 hr**

Radioactive materials: Regulatory requirements, hazards, handling, storage, disposal, emergency procedures. **2 hrs**

Fire safety **1 hr**

PQA-001E: THEORY AND PRACTICE OF ANALYTICAL AND BIOANALYTICAL METHOD DEVELOPMENT AND VALIDATION

(15 hrs)

1. Introduction to the concept of validation. **1 hr**
2. Development of analytical method using UV/PDA spectroscopy, Fluorimetry, HPLC, LC-MS/MS. **4 hrs**
3. Validation of the analytical method as per ICH-Q2(R1). **3 hrs**
4. Development of bioanalytical method using HPLC and LC-MS/MS. **2 hrs**
5. Validation of bioanalytical method as per USFDA guidance. **3 hrs**
6. Introduction to Novel upcoming technologies in bioanalysis like dry matrix spot analysis. **1 hr**
7. Introduction to Analysis of therapeutic proteins and peptides. **1 hr**

Evaluation

Formative: Development of validation protocols & problem-based learning. (30%)

Summative: Open book periodical tests & end semester exam. (70%)

PQA-002E: GOOD DOCUMENTATION PRACTICES AND E-DOCUMENTATION PRACTICES IN PHARMACEUTICAL INDUSTRY

(15 hrs)

1. Introduction to GDP and E – documentation **3 hrs**
2. Basic levels of documentation **6 hrs**
    a. Level -1, Level-2, Level-3 and Level-4 documentation
3. Case studies in each level **3 hrs**
4. Open lab and e-documentation concept **3 hrs**

PQA-003E: TROUBLE SHOOTING IN HIGH PERFORMANCE LIQUID CHROMATOGRAPHY

(15 hrs)

1. Introduction to HPLC modules and source of errors/malfunction in HPLC **5 hrs**
2. Startup preliminary checks for trouble shooting **6 hrs**
3. Trouble shooting in HPLC module wise including demonstration **4 hrs**

PQA-004E: PROFESSIONAL DEVELOPMENT

(15 hrs)

1. Introduction to Professional Career Development
2. Introduction to Career Planning: Self Assessment
3. Identifying Your Professional Talents
4. Introduction to Career Planning: Career Exploration
5. Developing Your Professional Resume
6. Enhancing Your Professional Resume
7. Preparing Your Career and Internship Cover Letters
8. Professional Communications
9. Preparing for Your Employment an Internship Interviews
10. Conducting Your Employment and Internship Interviews
11. Introduction to the Career Fair Search Process
12. Exploring Internship Options within Your Profession
13. Networking Search Strategies
14. Developing Your Professional Career Portfolio
15. Influencing Your Networking Partners
16. Essential practical skills and problem solving
17. communication of scientific information
18. IT skills.

Assessments:

- assignments
- case studies
- portfolios
- presentations

PQA-005E: STABILITY TESTING OF DRUGS AND BIOLOGICALS

(15 hrs)

1. Introduction to drug stability and its importance. **2 hrs**
2. Stability testing of drug substances and drug products as ICH Q1 series guidelines **11 hrs**
3. Stability testing of biotechnological/biological products as per ICH Q5C guidelines**. 2 hrs**

PQA-006E: USFDA DRUG REGULATORY AFFAIRS

(15 hrs)

1. Process of new drug development.
2. Contents of IND, NDA, CTD and eCTD, ANDA
3. SMF and DMF
4. Post marketing regulatory requirements.

PQA-007E: REST OF THE WORLD DRUG REGULATIONS

(15 hrs)

Legislation and regulations for import, manufacture, distribution and sale of drugs and pharmaceuticals in:

1. Brazil
2. ASEAN countries
3. CIS countries
4. GCC Countries.

PQA-008E: EVALUATION OF MEDICAL DEVICES

(15 hrs)

A. Biological evaluation of medical devices **10 hrs**

Scope, General principles applying to biological evaluation of medical devices, categorization of medical devices, testing, selection of biological evaluation tests, Assurance of test methods

B. Clinical evaluation of Medical devices **5 hrs**

Importance, scope, clinical evaluation in brief

PBT-001E: CLEAN ROOM CONCEPTS

(15 hrs)

Unit 1. Fundamental aspects of microbiology **3 hrs**

Morphology, Microscopy, Growth and Controlling Growth of Microorganisms.

Unit 2. Clean Room aspects **6 hrs**

Clean Room concepts, layout, facilities, HEPA and ULPA Filter, biosafety cabinets and various classes, biosafety levels, personnel controls.

Unit 3. Microbial monitoring, detection and enumeration of microorganisms **6 hrs**

Monitoring techniques, air samples, microbiological assessment of liquids, solids and semisolids, disposal of cultures.

REFERENCES

1. Cleanroom Microbiology for the Non-microbiology by David M. Carlberg, Second Edition CRC press, 2005.
2. Biopharmaceutical, Biochemistry and Biotechnology, Second Edition, Gary Walsh, Wiley Publishers, 2003.

PBT-002E: BIOSIMILARS

(15 hrs)

Unit -I Biosimilars- Introduction **7 hrs**

Definitions, Generics and Branded drugs, biosimilars, introduction to biologics, differences between biosimilars and generics, manufacturing process and technical challenges associated with production of biosimilar molecules, status of biosimilars. The role of patents in the drug industry and protein-based biopharmaceuticals.

Unit –II Guidelines on Similar Biologic: Regulatory Requirements for Registration and Marketing Authorization in India **8 hrs**

Principles for Development of Similar Biologics, Competent authorities, Selection of reference biologics, Quality consideration of similar biologics, Quality comparability study, Data requirement for preclinical study, clinical application and market authorisation, Post market data for similar biologics.

REFERENCES

1. Proposed guidelines for similar biologics in India, CDSCO.
2. Biosimilars and Interchangeable Biologics: Strategic Elements By Sarfaraz K. Niazi
3. Guidelines from Indian regulatory bodies such as CDSCO, DBT etc. issued time to time.
4. Relevant journals and periodicals.

PBT-003E: PRINCIPLES OF GENE CLONING

(15 hrs)

Unit I **3 hrs**

The aims of Gene Cloning: Techniques of gene manipulation, Outline of gene cloning.

Unit II **6 hrs**

Gene Cloning: Gene cloning procedure, tools required for gene cloning, cloning strategy, techniques for selection of clones, preservation of clones.

Unit III **6 hrs**

Applications of Gene Cloning: In production of therapeutic proteins, diagnostic proteins, transgenic animals and plants.

REFERENCES

1. Molecular biotechnology, Bernard R. Glick, Jack J. Pasternak, Cheryl L. Patten, 2010, ASM Press.
2. Biotechnology: The Biological Principles, M.D. Trevan, S. Boffey, K.H. Goulding and P. Stanbury. 1998, Tata McGraw Hill Edition.

PBT-004E: TISSUE ENGINEERING

(15 hrs)

Unit I **5 hrs**

Introduction to Tissue Engineering: Animal cell culture fundamentals, concept and need of tissue engineering, historical prospective, current status, industry challenges

Unit II **5 hrs**

Biomaterials for Tissue Engineering: Overview, features of scaffold and biomaterials, types of biomaterials, nanofiberous material as biomaterial.

Unit III **5 hrs**

Applications of Tissue Engineering: in Bone tissue regeneration, vascular tissue engineering, skin regeneration, cardiac tissue engineering and neural tissue engineering.

REFERENCES

1. Principles of Tissue Engineering, 4th Edition, Robert Vanza, Robert Langer, Joseph Vacanti. 2014, Academic Press.
2. Exploring Nanotechnology in Healthcare, Edited by N. Udupa,, 2013, Manipal University Press.

PPR-001E: RETAIL PHARMACY PRACTICE

(15 hrs)

1. Retail Pharmacy Management: Site selection, acquisition of premises for a retail pharmacy, layout of drug store, Legal aspects of retail pharmacy (includes Schedule N requirement), role of retail pharmacist and Code of ethics for practicing pharmacists. **4 hrs**
2. Purchase and inventory control, stocking, sale promotion, maintenance of records, economics and management **5 hrs**
3. Communication skills **2 hrs**
4. Medication therapy management **2 hrs**
5. Patient counselling **2 hrs**

REFERENCES

1. Philip P. Gerbino. Remington: The Science and Practice of Pharmacy. Philadelphia, PA. Lippincott Williams & Wilkins. (latest edition)
2. Revikumar KG,Miglani BD. A Text Book of Pharmacy Practice. Career Publications (latest edition)
3. G Parthasarathi, Karin Nyfort Hansen, Milep C Nahata. A Textbook of Clinical Pharmacy Practice Essential Concept and Skill. Oriental Longman Private Limited (latest edition)
4. Ashley WE, Justin J. Community and clinical pharmacy services: A step-by-step approach. The McGraw-Hill Companies, Inc, USA

PPR-002E: FUNDAMENTALS OF MEDICAL WRITING

(15 hrs)

I. Introduction **2 hrs**

- Brief overview of scientific writing
- Scope and importance
- Different types and areas of writing
- Career and opportunities

2. Basic Need To Be A Good **4 hrs**

- Language and Style in Medical Writing
- Literature search

  -Data bases (Medline, PubMed, Cochrane)

- Searching principles (using MeSH, Pub Med)
- Developing searching strategy by PICO

- Cortical Analysis Scientific Paper
- Ethics in Publication (Plagiarism, Copy Rights etc)
- Reference Writing

- Different bibliographic styles
-Citation databases
-Software used in reference writing

3. Different Types of Medical Writing **7 hrs**

- Structured abstract writing
- Report writing and sub-types
- Medication leaflets/pills
- Clinical research form
- Informed consent
- Protocol writing
- Case record form
- PSUR
- News letter

4. MANUSCRIPT WRTING AND PUBLICATION **2 hrs**

- ICMJE guidelines
- How to prepare structured manuscript (IMRA)
- Presentation of data (tables , figures and algorithms)
- Conflict of interest
- Acknowledgement
- Publication issues

Assignments: Preparation of power point, poster, abstract writing, review article with hand on training in publication issues

REFERENCES

1.Janice R Mathews, Jobin M Bowen and Robert W Mathews .Successful scientific writing- A step by step guide for the biological and medical sciences; 1996

2. Piyush Gupta, Navjeevan Singh. How to write thesis and thesis protocol-A primer for medical, dental & nursing courses; 2014
3. John Kirkman. Good style –Writing for science & Technology; 1994
4. Jennifer peat, Elizabeth Elliot, Louise Bour. Scientific writing-Easy when you know how; 1994.

PPR-003E: SYSTEMATIC REVIEW AND META-ANALYSIS

(15 hrs)

1. Study designs: Introduction to Case-control studies, Cohort studies, Randomized controlled trials **1 hr**
2. Applied statistics: Descriptive statistics, Hypothesis, Null-hypothesis, type-1 & type-2 errors, power, p-value, Confidence intervals, Odds ratio, Relative risk (risk ratio), Fixed effects & Random effects, Concept of homogeneity & heterogeneity and tests for heterogeneity, Various types bias and methods to detect bias, Funnel plot, Effect size & effect size indices, Forest plot **3 hrs**
3. Evidence based clinical practice: Definition, importance, levels of evidence. **1 hr**
4. Systematic review and meta-analysis: Definition, types, importance, applications, Meta-analysis groups (Campbell Collaboration, Cochrane Collaboration) **1 hr**
5. Steps involved in conducting Systematic review and Meta-analysis: **5 hrs**
   a. Framing the question
   b. Literature search
   c. Assessing the quality of studies
   d. Selection of studies
   e. Data synthesis & Analysis
   f.Summarizing the evidence
   g. Interpretation of the findings
6. Introduction to softwares used in meta-analysis: MedCalc, Comprehensive Meta-analysis software, RevMan, Open meta-analysis **1 hr**
7. Writing a meta-analysis protocol, Literature search, Data synthesis &analysis (Assignments) **3 hrs**

REFERENCES:

1. Higgins JPT, Green S, editors. Cochrane Handbook for Systematic Reviews of Interventions 4.2.6 [updated September 2006]. In: The Cochrane Library, Issue 4, 2006. Chichester, UK: John Wiley & Sons, Ltd.

2. Borenstein, M, Hedges LV, Higgins JPT, Rothstein HR. Introduction to Meta-Analysis. John Wiley & Sons, Ltd., 2009.

Pre-requisites: Knowledge of Biostatistics & Research Methodology, Web-based literature search

Evaluation: Based on Assignments

PPR-004E: PHARMACOKINETICS DATA ANALYSIS

(Employing WinNonlin)

(15 hrs)

1. Introduction to pharmacokinetic parameters: Elimination rate constant (ke), Elimination half-life, Bioavailability & AUC, Volume of distribution, Clearance, Bioequivalence 2 hrs
2. Bioavailability studies: In animal & human **2 hrs**
3. PK parameters for Oral & IV administration: Calculation of PK parameters for oral & IV administration by plotting concentration vs time graph (using semi-log graph paper) **2 hrs**
4. Introduction Phoenix WinNonlin: Data entry and data tools, graphs **2 hrs**
5. Non-compartmental analysis using (NCA) Phoenix WinNonlin: For Oral, IV, IV infusion, Sparse sampling and urinary excretion data **3 hrs**
6. Pharmacokinetic modeling: Compartment modelling, choosing the right compartment model, Simulating using PK model **2 hrs**
7. Bioequivalence data analysis: Parallel, Cross-over study data analysis **2 hrs**

REFERENCES

1. Gibaldi M, Perrier D. Pharmacokinetics. 2nd edition. Informa Healthcare; 2007.
2. Rowland M, Tozer TN. Clinical Pharmacokinetics: Concepts & Applications. 4th edition. Lippincott Williams& Wilkins;2011.
3. Phoenix WinNonlin examples guide. Pharsight. A Certara Company; 2012
4. Phoenix WinNonlin Users guide. Pharsight. A Certara Company; 2012.
5. Guidance for Industry: Bioavailability and Bioequivalence Studies Submitted in NDAs or INDs- General Considerations. US FDA. 2014.

Pre-requisites: Knowledge of basic pharmacokinetics.

Evaluation: Based on Assignments.

PHA-001E: CANCER BIOLOGY

(15 hrs)

Objectives/Course Outcomes

This course aims to provide students an extensive understanding about cancer and its effects on the human body. This course will also discuss the historical aspect of cancer research, basic chemotherapeutics and future scope in cancer research. All the topics will be presented in a simplified scientific manner with an emphasis on gaining a broad understanding of the disease.

1. Advanced Cell Biology- Structural and functional basis of cell, structure of chromosome and DNA, Cell cycle and its regulation. **3 hrs**
2. Molecular and genetic basis of cancer- Growth signaling, dysfunction of cell cycle leading to cancer, Oncogene, tumor suppressor gene, Apoptosis **6 hrs**
3. Cellular aspect of cancer- History of cancer, six hallmarks of cancer, Types of cancer, Metastasis, Cancer Prevention and Treatment. **3 hrs**
4. Current trends in Cancer research- Targets for development of cancer chemotherapeutics, its identification and relevance, Recent advancements in cancer therapy. **3 hrs**

PHA-002E: SCREENING METHODS FOR DRUG DEVELOPMENT

(15 hrs)

The course aims at providing the conceptual learning of a few basic pharmacological approaches to elucidate the pharmacological activity of a new chemical entity. The knowledge of screening methods facilitates the understanding of animal models, which closely mimics the human pathology, to screen the promising molecules for developing a new drug.

1. Introduction: General Screening techniques
2. Screening methods for local anesthetics
3. Screening methods for anti-hypertensive drugs
4. Screening methods for anti-arrhythmic drugs
5. Screening methods for anti-inflammatory drugs
6. Screening methods for analgesic drugs
7. Screening methods for antipyretic drugs
8. Screening methods for anticancer drugs
9. Screening methods for antidiabetic drugs

10. Screening methods for anti-dyslipidemia drugs
11. Screening methods for antiepileptic drugs
12. Screening methods for antidepressant drugs
13. Screening methods for antianxiety drugs
14. Screening methods for antiparkinsonian drugs
15. Screening methods for Alzheimer's disease related dementia

PHA-003E: FREE RADICAL BIOLOGY AND MEDICINE

(15 hrs)

Objectives

To provide fundamentals which are essential for researchers who wish to pursue problems of human health that involve free radicals, related oxidants, antioxidants, and antioxidant enzymes. Students will be able to understand, interpret, and critically think on issues associated with major causes of health problems.

1. Basics of free radicals in biology and medicine
2. Concept of oxidative stress in biology and diseases
3. Oxidative stress markers
4. Radical scavengers: The concept of antioxidants
5. Redox signaling and NRF2-ARE signaling mechanisms
6. Free radicals in inflammation and immune disorders
7. Free radicals in diabetes, obesity and metabolic disorders
8. Free radicals in cancer
9. Free radicals in cardiovascular diseases
10. Free radicals in neurodegenerative disorders
11. Free radicals and ageing
12. Free radicals in infectious diseases and antimicrobial-resistance
13. Free radicals in hepato-biliary diseases
14. Antioxidants screening methods: *In vitro* and *in vivo*
15. Recent advances in antioxidant discovery and development

Study material: Recent journal articles from reputed and Open Access Journals

PHA-004E: REGULATORY TOXICOLOGY IN DRUG DISCOVERY AND DEVELOPMENT

(15 hrs)

Objectives

This subject is to project the importance of safety testing in pre-clinical research and harmonized standards that they have to adopt for safety testing procedures.

Introduction: General Principles of Toxicology, Agencies and their guidelines regarding Toxicology studies, Concept of Good Laboratory practices. **3hrs**

Guidelines for safety testing

Pharmacological studies: Safety Pharmacology Studies for Human Pharmaceuticals, QT interval prolongation study in animals. **3 hrs**

Toxicity testing: Toxicokinetics: The Assessment of Systemic Exposure in Toxicity Studies, Pharmacokinetics: Guidance for Repeated Dose Tissue Distribution Studies, Acute, subacute and Chronic toxicity in animals **4 hrs**

Special toxicity studies: Non-clinical Carcinogenicity studies, Genotoxicity studies, Reproductive toxicology, Immunotoxicity, Safety evaluation of Biotechnology- derived products. **5 hrs**

PCO-001E: NUTRACEUTICALS

(15 hrs)

Scope

Nutraceuticals:The food or part of food with additional health benefits are emerging as major health supplements for prevention, management and some-times cure of various diseases. In the current fast lifestyle, nutraceuticals are encroaching pharma markets not only in the developed but also in the developing countries. Therefore, an additional knowledge in nutraceuticals or health supplements add an edge to the student.

Objectives

The course proposes to offer a comprehensive knowledge on the nutraceuticals and their importance to prepare the student for a pursuit in the health food sector.

1. Introduction to nutraceuticals: Overview, classification, benefits of nutraceuticals, functional foods **3 hrs**
2. In organic supplements and vitamins **1 hr**
3. Probiotics, prebiotics and digestive enzymes **1 hr**
4. Dietary supplements and fibres **1 hr**
5. Antioxidants and PUFAs **2 hrs**

6. Herbs as health foods: Poly phenols and flavonoids (*Ginkgo biloba*, Tea, Citrus fruits, Grape, Soy); Carotene and fatty acids: (Curcuma, Tomato, Flax seed, Olive oil) **5 hrs**
7. Current market scenario of nutraceuticals **1 hr**
6. Regulatory requirements for nutraceuticals **1 hr**

REFERENCES

1. Biren Shah and A.K. Seth. Text Book of Pharmacognosy and Phytochemistry, Ed1, Elsevier Health Sciences, Gurgaon, Haryana, 2010. Pp 471-83
2. S.S. Agrawal and M. Paridhavi. Herbal Drug Technology, Ed2, Universities Press, Hyderabad, Telangana, 2012. Pp 710-21
3. Alberta N.A. Aryee and Joyce Irene Boye, Current and Emerging Trends in the Formulation and Manufacture of Nutraceuticals and Functional Food products, In, Nutraceutical and Functional Food Processing Technology Edt. Joyce Irene Boye, Ed.1. Wiley Blackwell, West Sussex UK, 2015. Pp 01-52
4. Rorimi E. Aluko, Functional Foods and Nutraceuticals Springer, New York, USA, 2012.
5. C.K Kokate, A.P. Purohot and S.B. Gokhale, Pharmacognosy, Vol 1 and 2, Ed. 46, Nirali Prakashan, Pune, 2010. Pp 6.01-6.16

PCO-002E: EXTRACTION, SEPARATION AND PURIFICATION OF PHYTOCONSTITUENTS

(15 hrs)

Scope

Herbal drugs are emerging as major source of biomedicines worldwide. Secondary metabolites or phytoconstituents are responsible for medicinal attributes of a plant. Extraction, separation, and purification of these secondary metabolite is an area of interest for researchers. Therefore, this subject will provide an insight on the topic so as to enable the students to carry their research on natural products effectively**.**

Objectives

To impart stronger scientific base in the area of extraction, isolation and purification principles and methodologies of crude drugs.

1. Introduction to plant metabolites. **1 hr**
2. Extraction techniques: Principle, merits & demerits, applications of maceration, decoction, infusion, percolation, soxhlet extraction, supercritical fluid extraction, microwave-assisted extraction, ultrasound extraction (sonication), advanced phytonics method of extraction, expression and enfleurage method. **5 hrs**
3. Phytochemical screening of natural products **2 hrs**
4. Separation and purification of phytoconstituents: Fractional distillation, fractional liberation, sublimation, fractional crystallization, gel filtration, counter current extraction and chromatographic techniques like Paper Chromatography, TLC, HPLC, HPTLC, column chromatography, gas-liquid chromatography, droplet counter current chromatographyand electro-chromatography (Electrophoresis). **7 hrs**

REFERENCES

1. Evans W. C., Trease G. E., Trease and Evan's Pharmacognosy. W.B. Saunders, 2002. 16th Ed.
2. Jean Bruneton, Caroline K. Hatton, Pharmacognosy, Phytochemistry, Medicinal Plants. Lavoisier, 1999
3. Kokate C.K., Gokhale S.B. and Purohit A.P., Textbook of Pharmacognosy, Nirali Prakashan, Pune, 2008
4. Mukherjee Pulok K., Quality Control of Herbal Drugs: An Approach to Evaluation of Botanicals. Business Horizons, 2002.

PCO-003E: NANOPHYTOPHARMACEUTICALS

(15 hrs)

Scope

Nanotechnology is a cutting-edge technology that provides optimal effectiveness in low doses. The course addresses and provides an overview of phytopharmaceuticals in nano size for better therapeutic benefits along with toxicity. Students will be able to understand the benefits of nano-phytopharmaceuticals.

Objectives

To study the effectiveness in low doses and enhancement of bioavailability of phytopharmaceuticals for better therapeutic values

1. Definition and history of nanotechnology **1 hr**
2. Properties – optical, electrical and magnetic properties of nanomaterials **2 hrs**
3. Preparation techniques – Polymeric nanoparticles, liposomes, micelles and herbal nanoparticles **6 hrs**
4. Toxicity studies **2 hrs**
5. Applications of phytopharmaceuticals, nanophytopharmaceuticals in the treatment of certain diseases **4 hrs**

REFERENCES

1. Nano: The Essentials: Understanding Nanoscience and Nanotecnology, T. Pradeep, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2008.
2. Nanocrystals: Synthesis, Properties and Applications, C. N. R. Rao, P. J. Thomas and G. U. Kulkarni, Springer (2007)
3. Nanostructures & Nanomaterials: Synthesis, Properties & Applications, Guozhong Cao, Imperial College Press (2004).
4. Nanoparticles as Drug carriers, Vladimir P Torchilin, Imperial College Press, USA, 2006
5. Multifunctional Pharmaceutical Nanocarriers, Vladimir Torchilin, Springer Publishing, New York, NY, 2008.

PCO-004E: HERBAL MONOGRAPHS

(15 hrs)

Scope

A monographs is written document intended to promote information exchange and international harmonised standards for the quality control and use of herbal medicines. It contains scientific information on selected medicinal plants that serves as a summary for quality assurance, clinical applications and dosage forms. The proposed course is designed to study and understand herbal monographs

Objectives

To impart knowledge on systematic study of herbal drugs with reference its identity, quality and purity

1. Introduction to monographs, purpose and content of the monographs, use of the monographs **3 hrs**

2. Systematic study of the following important plants for their monographs; **12 hrs**

   Leaf: Vasaka (*Adhatoda zeylanica)*

   Root: Shatavari (*Asparagus racemosus)*

   Rhizome:Rasna *(Alpinia galanga)*

   Bark: Cinchona (*Cinchona officinalis)*

   Fruit: Pepper (*Piper nigrum)*

   Entire herb: Kalmegh *(Andrographis paniculata).*

REFERENCES

1. WHO monographs on selected medicinal plants. – Geneva: WHO. – Vol. 1. 1999, – Vol. 2. 2002, – Vol. 3: 2004, – Vol. 4. 2005.
2. Quality Standards of Indian Medicinal Plants – Indian Council of Medical Research, New Delhi.
3. Indian Herbal Pharmacopoeia – A Joint Publication of RRL, Jammu and IDMA, Mumbai.

PRM-001E: RETAIL BUSINESS MANAGEMENT

(15 hrs)

Scope

This course is formulated to impart knowledge on retail management. It also provides an overview about the nitty-gritties of managing a pharmacy store and an overview of Online Pharmacies.

1. Introduction to Retail Management **3 hrs**
2. Strategies in Retailing **3 hrs**
3. Retail Marketing in rural areas **3 hrs**
4. Pharmacy Store Management **4 hrs**
5. Online Pharmacy Retailing **2 hrs**

REFERENCES

1. Retail Management by Barry Berman. Person Education 11th Edition.
2. Retail Management by Chetan Bajaj. Oxford 2nd Edition.
3. Retail Management: Text and Cases by UC Mathur. IK International Publishing House Pvt. Ltd.

PRM-002E: INTELLECTUAL PROPERTY MANAGEMENT

(15 hrs)

Scope

This course deals with Intellectual Property Rights with special emphasis on Patents.

1. Basic Concepts of Intellectual Property Rights	**3 hrs**
2. Patent Administration in India and Patent Filing	**3 hrs**
3. Revocation of Patents and Patent Infringement Cases	**3 hrs**
4. Data Protection and Exclusivity	**3 hrs**
5. Patent as a business tool	**3 hrs**

REFERENCES

1. Basic Concepts of Intellectual Property Rights by Manthan D Janodia. Manipal University Press, 2015.

2. Intellectual Property Rights by SRS Rosedar. Lexis Nexis 2016.

3. Intellectual Property Rights in India by VK Ahuja. Lexis Nexis, 2015.

4. Law relating to Intellectual Property by BL Wadehra. Universal Law Publishing, 2016.

PRM-003E: GENERAL MANAGEMENT PRINCIPLES

(15 hrs)

Scope

This course is designed to facilitate students to inculcate managerial skills. It includes major concepts of management.

1. Introduction to management concepts	**3 hrs**
2. Decision Making	**3 hrs**
3. Leadership and Motivation	**4 hrs**
4. Conflict Management	**3 hrs**
5. Ethical Issues related to Management	**2 hrs**

REFERENCES

1. Organisational Behaviour by Stephen P. Robbins, Prentice – Hall, India

2. Management, A global Perspective by Heinz, Weihrich and Harold Koontz. Mc Graw Hill publishing company.

3. Management, tasks, responsibilities and practices by Drucker. Peter. F., Alfied Publisher Pvt. Ltd.

4. Principles and Practice of Management by L M Prasad, Sultan Chand & Sons.

PRM-004E: ENTREPRENEURSHIP DEVELOPMENT

(15 hrs)

Scope

This course is designed to impart knowledge and skills on entrepreneurship development.

1. Entrepreneur and Entrepreneurship	**3 hrs**
2. Entrepreneurial Development	**3 hrs**
3. Launching and Organizing an enterprise	**3 hrs**
4. Cost and Pricing	**3 hrs**
5. Project proposal development for start-up	**3 hrs**

REFERENCES

1. Hisrich, R.D. and Peters, M.P. (1995): Entrepreneurship – Starting, Developing and Managing a New Enterprise, Richard D., Inwin, INC, USA.

2. Meredith, G.G. etal (1982): Practice of Entrepreneurship, ILO, Geneva.

3. Entrepreneurship Management by Vasant Desai. Himalaya Publishing House, 2011.

MPHARM – CHOICE BASED MULTIDISCIPLINARY COURSE

- **MU-001E: Certificate Course in Bioinformatics**
- **MU-002E: Project Management**
- **MU-003E: Certificate Course in Bioethics**
- **MU-004E: Academic Research and Writing**
- **MU-005E: Certificate Course in Biosecurity**

(As prescribed from time to time)