RAMAIAH UNIVERSITY OF APPLIED SCIENCES

M.S. Ramaiah University of Applied Sciences

Programme Structure and Course Details of

M. Pharm Pharmaceutical Chemistry

2022-2024

Programme Code: 057

Registrar
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Faculty of Pharmacy

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

Dean - Academics
M.S. Ramaiah University of Applied Sciences

University's Vision, Mission and Objectives

The M. S. Ramaiah University of Applied Sciences (MSRUAS) will focus on student-centric professional education and motivates its staff and students to contribute significantly to the growth of technology, science, economy and society through their imaginative, creative and innovative pursuits. Hence, the University has articulated the following vision and objectives.

Vision

MSRUAS aspires to be the premier university of choice in Asia for student centric professional education and services with a strong focus on applied research whilst maintaining the highest academic and ethical standards in a creative and innovative environment

Mission

Our purpose is the creation and dissemination of knowledge. We are committed to creativity, innovation and excellence in our teaching and research. We value integrity, quality and teamwork in all our endeavors. We inspire critical thinking, personal development and a passion for lifelong learning. We serve the technical, scientific and economic needs of our Society.

Objectives

1. To disseminate knowledge and skills through instructions, teaching, training, seminars, workshops and symposia in Engineering and Technology, Art and Design, Management and Commerce, Health and Allied Sciences, Physical and Life Sciences, Arts, Humanities and Social Sciences to equip students and scholars to meet the needs of industries, business and society
2. To generate knowledge through research in Engineering and Technology, Art and Design, Management and Commerce, Health and Allied Sciences, Physical and Life Sciences, Arts, Humanities and Social Sciences to meet the challenges that arise in industry, business and society
3. To promote health, human well-being and provide holistic healthcare
4. To provide technical and scientific solutions to real life problems posed by industry, business and society in Engineering and Technology, Art and Design, Management and Commerce, Health and Allied Sciences, Physical and Life Sciences, Arts, Humanities and Social Sciences
5. To instill the spirit of entrepreneurship in our youth to help create more career opportunities in the society by incubating and nurturing technology product ideas and supporting technology backed business
6. To identify and nurture leadership skills in students and help in the development of our future leaders to enrich the society we live in
7. To develop partnership with universities, industries, businesses, research establishments, NGOs, international organizations, governmental organizations in India and abroad to enrich the experiences of faculties and students through research and developmental Programmes

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Faculty	Pharmacy
Department	Pharmaceutical Chemistry
Programme Code	057
Programme Name	M. Pharm. Pharmaceutical Chemistry
Dean of the Faculty	Dr. S. Bharath
HOD	Dr. D.R. Harish Kumar

1. **Title of the Award:** M. Pharm. in Pharmaceutical Chemistry
2. **Mode of Study:** Full-Time
3. **Awarding Institution /Body:** M. S. Ramaiah University of Applied Sciences, Bengaluru
4. **Joint Award:** Not Applicable
5. **Teaching Institution:** Faculty of Pharmacy, M. S. Ramaiah University of Applied Sciences, Bengaluru
6. **Date of Programme Specifications:** July 2022
7. **Date of Programme Approval by the Academic Council of MSRUAS:** 06 April 2017
8. **Next Review Date:** June 2024
9. **Programme Approving Regulating Body and Date of Approval:** Pharmacy Council of India
10. **Programme Accredited Body and Date of Accreditation:** Not Applicable
11. **Grade Awarded by the Accreditation Body:** Not Applicable
12. **Programme Accreditation Validity:** Not Applicable
13. **Programme Benchmark:** Not Applicable
14. **Rationale for the Programme**

In the post GATT era, there is a need for vast and speedy research to obtain new drug molecules for clinical use and a post graduate course in Pharmaceutical Chemistry provides the requisite man-power towards the same. Further, the indiscriminate use medicinal agents will have deleterious effects on the health of human population. Anti-microbial agents for instance are becoming ineffective due to the development of resistance by the microbes and this in turn requires the development of large number of new drug molecules. This situation augments the requirement of trained professionals in rational drug design. The new drugs developed need standardization by quality control procedures which in turn are fulfilled by the trained post graduates to develop newer methods of analysis. These Post graduates also play a major role in academics to train the students in developing them as future pharmacists.

The M. S. Ramaiah College of Pharmacy, now a constituent of MSRUAS as Faculty of Pharmacy has been in existence for about three decades. Over the years, Faculty of Pharmacy of MSRUAS has grown and evolved as one of the Premier Institutions in the state of Karnataka. It has very good infrastructure, noteworthy laboratory facilities, experienced and competent faculty members. During the last two decades it has produced over 1000 graduates and 120 Post graduates. The presence of other Faculties of applied sciences in the University will facilitate the students to have a better experience and exposure in comparison to the conventional training procedures.

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangaloro - 54.

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Faculty of Pharmacy of MSRUAS offers M. Pharm degree Programme in Pharmaceutical Chemistry which is featured with semester pattern curriculum is aimed to emphasize critical thinking, analytical and problem-solving skills and outcome-based curriculum. Importance will be given to research projects based on rational drug design. The curriculum is structured to develop the students for taking up independent professional responsibilities and acquire necessary skills to compete with their global counterparts.

15. Programme Mission

The aim of the Programme is to produce proficient postgraduates with advanced knowledge and skills in designing, synthesizing and developing analytical methods for analysis of medicinal agents and pharmaceuticals.

16. Graduate Attributes (GAs)

GA-1. **Pharmacy Knowledge:** Ability to acquire knowledge and comprehend the core and basic knowledge associated with the profession of pharmacy, including biomedical sciences; pharmaceutical sciences; behavioral, social, and administrative pharmacy sciences; and manufacturing practices.

GA-2. **Planning Abilities:** Ability to demonstrate effective planning including time management, resource management, delegation skills and organizational skills. Also, to develop and implement plans and organize work to meet deadlines.

GA-3. **Problem analysis:** Ability to utilize the principles of scientific enquiry, thinking analytically, clearly and critically, while solving problems and making decisions during daily practice. Find, analyze, evaluate and apply information systematically and shall make defensible decisions.

GA-4. **Modern tool usage:** Ability to learn, select, and apply appropriate methods and procedures, resources, and modern pharmacy-related computing tools with an understanding of the limitations.

GA-5. **Leadership skills:** Ability to understand and consider the human reaction to change, motivation issues, leadership and team-building when planning changes required for fulfillment of practice, professional and societal responsibilities. Also, to assume participatory roles as responsible citizens or leadership roles when appropriate to facilitate improvement in health and well- being.

GA-6. **Professional Identity:** Ability to understand, analyze and communicate the value of their professional roles in society (e.g., health care professionals, promoters of health, educators, managers, employers, employees).

GA-7. **Pharmaceutical Ethics:** Ability to honor personal values and apply ethical principles in professional and social contexts. Demonstrate behavior that recognizes cultural and personal variability in values, communication and lifestyles. Use ethical frameworks; apply ethical principles while making decisions and take responsibility for the outcomes associated with the decisions.

GA-8. **Communication:** Ability to communicate effectively with the pharmacy community

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

and with society at large, such as, being able to comprehend and write effective reports, make effective presentations and documentation, give and receive clear instructions.

GA-9. **The Pharmacist and society:** Ability to apply reasoning informed by the contextual knowledge to assess societal, health, safety and legal issues and the consequent responsibilities relevant to the professional pharmacy practice.

GA-10. **Environment and sustainability:** Ability to understand the impact of the professional pharmacy solutions in societal and environmental contexts, and demonstrate the knowledge of and need for sustainable development.

GA-11. **Life-long learning:** Ability to recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change. Self- assess and use feedback effectively from others to identify learning needs and to satisfy these needs on an ongoing basis.

17. Programme Outcomes (POs)

M. Pharm. graduates will be able to:

PO-1. **Pharmacy Knowledge:** Possess knowledge and comprehension of the core and basic knowledge associated with the profession of pharmacy, including biomedical sciences; pharmaceutical sciences; behavioral, social, and administrative pharmacy sciences; and manufacturing practices.

PO-2. **Planning Abilities:** Demonstrate effective planning abilities including time management, resource management, delegation skills and organizational skills. Develop and implement plans and organize work to meet deadlines.

PO-3. **Problem analysis:** Utilize the principles of scientific enquiry, thinking analytically, clearly and critically, while solving problems and making decisions during daily practice. Find, analyze, evaluate and apply information systematically and shall make defensible decisions.

PO-4. **Modern tool usage:** Learn, select, and apply appropriate methods and procedures, resources, and modern pharmacy-related computing tools with an understanding of the limitations.

PO-5. **Leadership skills:** Understand and consider the human reaction to change, motivation issues, leadership and team-building when planning changes required for fulfillment of practice, professional and societal responsibilities. Assume participatory roles as responsible citizens or leadership roles when appropriate to facilitate improvement in health and well- being.

PO-6. **Professional Identity:** Understand, analyze and communicate the value of their professional roles in society (e.g. health care professionals, promoters of health, educators, managers, employers, employees).

PO-7. **Pharmaceutical Ethics:** Honor personal values and apply ethical principles in professional and social contexts. Demonstrate behavior that recognizes cultural and personal variability in values, communication and lifestyles. Use ethical frameworks;

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

apply ethical principles while making decisions and take responsibility for the outcomes associated with the decisions.

PO-8. Communication: Communicate effectively with the pharmacy community and with society at large, such as, being able to comprehend and write effective reports, make effective presentations and documentation, and give and receive clear instructions.

PO-9. The Pharmacist and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety and legal issues and the consequent responsibilities relevant to the professional pharmacy practice.

PO-10. Environment and sustainability: Understand the impact of the professional pharmacy solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO-11. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change. Self- assess and use feedback effectively from others to identify learning needs and to satisfy these needs on an ongoing basis.

18. Programme Goal

The Programme goal is to produce proficient postgraduates with advanced knowledge and skills in designing, synthesizing and analysis of medicinal agents and pharmaceuticals.

19. Programme Educational Objectives (PEOs)

The objectives of the M. Pharm Programme in Pharmaceutical Chemistry are to:

PEO-1. Provide students with various advancements in pharmaceutical Chemistry to enable them to devise and deliver efficient solutions to challenging problems in Pharmacy and allied disciplines

PEO-2. Impart analytic and cognitive skills required to develop innovative solutions for R&D, Industry, and societal requirements

PEO-3. Provide sound knowledge of pharmacy, managerial and entrepreneurial skills to enable students to contribute to the well-being and welfare of the society

PEO-4. Inculcate strong human values and social, interpersonal and leadership skills required for professional success in evolving global professional environments

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

20. Programme Specific Outcomes (PSOs)

At the end of the M. Pharm program in Pharmaceutical Chemistry, the graduate will be able to:

PSO-1. Apply the knowledge to ensure the quality of drugs and pharmaceuticals by using various modern techniques to develop innovative and safe solutions to real-world problems

PSO-2. Adapt to various advancements in synthesis of various drug molecules, summarize the concepts of QSAR and CADD and elucidate structures of natural products of medicinal interest

PSO-3. Acquire the leadership qualities and strive for the betterment of organization, environment, and society

PSO-4. Demonstrate an understanding of the importance of life-long learning through professional development, practical training, and specialized certifications

M.S. Ramaiah University of Applied Sciences * Bangalore - 560054 *

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

21. Programme Structure:

Table 1 Programme Structure

SEMESTER – I			
Course Code	Course	Credits	Hours/Week
DEPARTMENT COMMON COURSE			
PCF501	1.Modern Pharmaceutical Analytical Techniques	4	4
PROGRAMME SPECIALIZATION COURSES			
PCC502	1.Advanced Organic Chemistry – I	4	4
PCC503	2.Advanced Medicinal Chemistry	4	4
PCC504	3.Chemistry of Natural Products	4	4
PCL505	4. Pharmaceutical Chemistry Practical I	6	12
PCS506	5.Seminar / Assignment	4	7
SEMESTER - II			
PROGRAMME SPECIALIZATION COURSES			
PCC507	1.Advanced Spectral Analysis	4	4
PCC508	2 Advanced Organic Chemistry – II	4	4
PCC509	3.Computer Aided Drug Design	4	4
PCC510	4. Pharmaceutical Process Chemistry	4	4
PCL511	5. Pharmaceutical Chemistry Practical II	6	12
PCS512	6.Seminar / Assignment	4	7
SEMESTER - III			
FACULTY COMMON SPECIALIZATION COURSES			
PCF613	1.Research Methodology and Biostatistics	4	4
PCF614	2.Journal Club	1	1
PCF615	3.Group Project	4	-
PCF616	4.Discussion / Presentation (Proposal Presentation)	2	2
PCF617	5.Research Work	14	28
SEMESTER - IV			
PROGRAMME SPECIALIZATION COURSES			
PCF618	1.Journal Club	1	1
PCF619	2. Discussion / Presentation	3	3
PCF620	3. Research Work	16	31
	MANDATORY COURSE/S		
PCF621	1.Participation/Presentation in research forum: National / International Seminar, Conferences, Workshops	1-3	-
PCF622	2.Publication: National / International Journals		-
PCF623	3.Academic/Research award: State/National/International Agencies		-

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

Dean - Academics
M.S. Ramaiah University of Applied Sciences

22. Course Delivery: As per the Timetable

23. Teaching and Learning Methods

1. Face to Face Lectures using Audio-Visuals
2. Workshops, Group Discussions, Debates, Presentations
3. Demonstrations
4. Guest Lectures
5. Laboratory work/Field work/Workshop
6. Industry Visit
7. Seminars
8. Group Exercises
9. Project Work
10. Project
11. Exhibitions
12. Technical Festivals

24. Assessment and Grading

Table 2 Assessment and Grading

Semester I

Course code	Name of Course	Internal Assessment				Semester End Examination		Total marks
		Continuous Mode	Sessional Exams		Total	Marks	Duration	
			Marks	Duration				
PCF501	1.Modern Pharmaceutical Analytical Techniques	10	15	1 h	25	75	3 h	100
PCC502	2.Advanced Organic Chemistry – I	10	15	1 h	25	75	3 h	100
PCC503	3.Advanced Medicinal Chemistry	10	15	1 h	25	75	3 h	100
PCC504	4.Chemistry of Natural Products	10	15	1 h	25	75	3 h	100
PCC505	5. Pharmaceutical Chemistry Practical I	20	30	6 h	50	100	6 h	150
PCC506	6.Seminar / Assignment	-	-	-	-	-	-	100

Semester II

Course code	Name of Course	Internal Assessment				Semester End Examination		Total marks
		Continuous Mode	Sessional Exams		Total	Marks	Duration	
			Marks	Duration				
PCC507	1.Adanced Spectral Analysis	10	15	1 h	25	75	3 h	100
PCC508	2 Advanced Organic Chemistry – II	10	15	1 h	25	75	3 h	100
PCC509	3.Computer Aided Drug Design	10	15	1 h	25	75	3 h	100
PCC510	4. Pharmaceutical Process Chemistry	10	15	1 h	25	75	3 h	100
PCC511	5. Pharmaceutical Chemistry Practical II	20	30	6 h	50	100	6 h	150
PCC512	6.Seminar / Assignment	-	-	-	-	-	-	100

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Semester III

Course code	Name of Course	Internal Assessment				Semester End Examination		Total marks
		Continuous Mode	Sessional Exams		Total	Marks	Duration	
			Marks	Duration				
PCF613	1.Research Methodology and Biostatistics	10	15	1 h	25	75	3h	100
PCF614	2.Journal Club	-	-	-	25	-	-	25
PCF615	3.Group Project	-	-	-	-	-	-	-
PCF616	4.Discussion / Presentation (Proposal Presentation)	-	-	-	50	-	-	50
PCF617	5.Research Work	-	-	-	-	350	1 h	350

Semester IV

Course code	Name of Course	Internal Assessment				Semester End Examination		Total marks
		Continuous Mode	Sessional Exams		Total	Marks	Duration	
			Marks	Duration				
PCF618	1.Journal Club	-	-	-	25	-	-	25
PCF619	2. Discussion /Presentation	-	-	-	75	-	-	75
PCF620	3. Research Work	-	-	-	-	400	1 h	400

24.1 Components of Grading

There shall be **two components** of grading in the assessment of each course:

Component 1, Continuous Evaluation (CE): This component involves multiple subcomponents (SC1, SC2, etc.) of learning assessment. The assessment of the subcomponents of CE is conducted during the semester at regular intervals. This subcomponent represents the formative assessment of students' learning.

Component 2, Semester-end Examination (SEE): This component represents the summative assessment carried out in the form an examination conducted at the end of semester.

Marks obtained CE and SEE components have a weightage of 25:75 (CE:25% and SEE: 75%) in determining the final marks obtained by a student in a Course.

The complete details of Grading are given in the Academic Regulations.

24.2 Continuous Evaluation Policies

Continuous evaluation depends on the type of the course as discussed below:

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

24.2.1 Theory Courses

Focus of COs on each Component or Subcomponent of Evaluation				
	Component 1: CE (25% Weightage)			Component 2: SEE (75% Weightage)
Subcomponent ▶	SC1	SC2	SC3	
Subcomponent Type ▶	Attendance	Student – Teacher Interaction	Sessional Exam	Semester End Examination 75 Marks
Maximum Marks ▶	8	2	15	
CO-1				
CO-2				
CO-3				
CO-4				
CO-5				
CO-6				
The details of SC1, SC2, SC3 are presented in the Programme Specifications Document.				

24.2.2 Laboratory Courses

Focus of Cos on each Component or Subcomponent of Evaluation				
	Component1: CE(25%Weightage)			Component2: SEE (75%Weightage)
Subcomponent▶	SC1	SC2	SC3	
Subcomponent Type ▶	Attendance	Student – Teacher Interaction	Sessional Exam	Semester End Examination 100 Marks
Maximum Marks▶	10	10	30	
CO-1				
CO-2				
CO-3				
CO-4				
CO-5				
The details of SC1,SC2,SC3 are presented in the Programme Specifications Document.				

Table 3:- Scheme for awarding Continuous Evaluation-Theory

Criteria	Maximum Marks
Attendance*	8
Student-Teacher Interaction**	2
Total	10

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore-560 054

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54,

Table 4:- Guidelines for the allotment of marks for attendance*

Percentage of Attendance	Theory
95 – 100	8
90 – 94	6
85 – 89	4
80 – 84	2
Less than 80	0

Theory

(Component -1: 25 Marks + Component-2: 75Marks)

Component - 1: - 25 Marks

It has two sub-components (Part A & B)

Part – A: Continuous Evaluation: 10 Marks

The marks allocated for Continuous mode of internal assessment shall be awarded as per the scheme given below:

Table 3:- Scheme for awarding Continuous Evaluation-Theory

Criteria	Maximum Marks
Attendance*	8
Student-Teacher Interaction**	2
Total	10

** student will be continuously assessed during theory and practical sessions

Table 4:- Guidelines for the allotment of marks for attendance*

Percentage of Attendance	Theory
95 – 100	8
90 – 94	6
85 – 89	4
80 – 84	2
Less than 80	0

Part – B: Sessional Examination: 15 Marks

Two sessional examinations (each for 15 Marks with one hour duration) will be conducted. Average marks of the two sessionals will be computed for sessional examination marks.

Component -2 Semester End Theory Examination: 75 Marks

Theory Examination: A theory exam shall be conducted for maximum marks 75 Marks with three hours of duration

Practical – 150 Marks

(Component -1: 50 Marks + Component-2: 100 Marks)

Component - 1: - 50 Marks

It has two sub-components (Part A & B)

Part – A: Continuous Evaluation: 20 Marks

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

The marks allocated for Continuous mode of internal assessment shall be awarded as per the scheme given below:

Scheme for awarding Continuous Evaluation -Practical

Criteria	Maximum Marks
Attendance*	10
Practical Records, Regular viva-voce**	10
Total	20

Guidelines for allotment of marks for attendance*

Percentage of Attendance	Practical
95 – 100	10
90 – 94	7.5
85 – 89	5
80 – 84	2.5
Less than 80	0

Part – B: Sessional Examination: 30 Marks

Two sessional examinations (each for 30 Marks with six-hour duration) will be conducted. Average marks of the two sessionals will be computed for sessional examination marks.

Component -2 Semester End Practical Examination: 100Marks

Practical Examination: 100 Marks with six hours of duration. Practical examination shall also consist of a viva –voce (Oral) examination.

The assessment questions are set to test the learning outcomes. In each component a certain learning outcome is assessed.

Note: For more details on the break-ups, please refer to the Course Specifications

A student is required to score an overall 50% for successful completion of a course and earn the credits.

Note: Final marks awarded in each of the courses will be confirmed only after SAB/PAB as explained in Academic Regulations of M. Pharm. Programme.

Assignment & Seminar

The detailed procedure and evaluation procedure is available in the Operation Manual / Student Handbook/Academic Regulations.

Journal Club

The detailed procedure and evaluation procedure is available in the Operation Manual / Student Handbook/Academic Regulations.

Group Project

The detailed procedure and evaluation procedure is available in the Operation Manual / Student Handbook/Academic Regulations

M.S. Ramaiah University of Applied Sciences * Bangalore

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

Mandatory Courses

The credit points assigned for extracurricular and or co-curricular activities shall be given by the Dean of the Faculty and the same shall be submitted to the University.

Name of the Activity	Maximum credit points Eligible /Activity
Participation in National level Seminar/ Conference / Workshop/Symposium/Training Programs	01
Participation in International level outside India 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

Dissertation/Research Work

1. Every candidate shall carry out work on an assigned research project under the guidance of a recognized Postgraduate Teacher, the result of which shall be written up and submitted in the form of a dissertation.
2. Work for writing the Dissertation is aimed at contributing to the development of spirit of enquiry, besides exposing the candidate to the techniques of research, critical analysis, acquaintance with the latest advances in pharmaceutical/medical sciences and the manner of identifying and consulting available literature. Dissertation shall be submitted as per the notified time schedule mentioned in the Academic calendar / student hand book.
3. The Dissertation and viva-voce shall be evaluated by two examiners, one Internal and one External examiner appointed by the University.

Scheme of Evaluation of Dissertation book:

Objective(s) of the work done: 50 Marks
Methodology adopted: 150 Marks
Results and Discussions: 250 Marks
Conclusions and Outcomes: 50 Marks

Total: 500 Marks

Scheme of Evaluation of Presentation:

Presentation of work: 100 Marks
Communication skills: 50 Marks
Question and answer skills: 100 Marks

Total: 250 Marks

A student is required to score a minimum of 50% overall for successful completion of Dissertation and earn the corresponding credits.

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

Dean - Academics
M.S. Ramaiah University of Applied Sciences

Supplementary/re-registration examination and improvement of sessional marks

The eligibility criteria and procedures for supplementary examination and improvement of sessional marks are as per the Pharmacy Council of India (PCI) norms and as indicated in the Academic Regulations governing this Programme.

25. Student Support for Learning

1. Course Notes
2. Reference Books in the Library
3. Magazines and Journals
4. Internet Facility
5. Computing Facility
6. Laboratory Facility
7. Workshop Facility
8. Staff Support
9. Lounges for Discussions
10. Any other support that enhances their learning

26. Quality Control Measures

1. Review of Course Notes
2. Review of Question Papers and Assignment Questions
3. Student Feedback
4. Moderation of Assessed Work
5. Opportunities for students to see their assessed work
6. Review by external examiners and external examiners reports
7. Staff Student Consultative Committee meetings
8. Student exit feedback
9. Subject Assessment Board (SAB)
10. Programme Assessment Board (PAB)

Registrar
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

27. Programme Map (Course-PO-PSO Map)

Sem.	Course Title	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PSO-1	PSO-2	PSO-3	PSO-4
1	Modern Pharmaceutical Analytical Techniques	3		2	2		1	1	1			1	3	3		2
1	Advanced Organic Chemistry – I	3		2	2				1			1	3	3		2
1	Advanced Medicinal Chemistry	3	2	2	1			1	1			2	3	2		1
1	Chemistry of Natural Products	3	2	3	3			2	2		2	2	3	3	3	3
1	Pharmaceutical Chemistry Practical I	3	2	1	2			2	1			1	2	2		1
1	Seminar / Assignment	3	3	2	3	2	2	2	3	1	2	3	1	1	2	3
2	Advanced Spectral Analysis	3		2	3			1	2			2	3	3	1	1
2	Advanced Organic Chemistry – II	3	2	2	3			1	1	1	2	1	3	2		2
2	Computer Aided Drug Design	3		3	3			2	2		2	3	3	3	2	3
2	Pharmaceutical Process Chemistry	3	2	3	3	1			1		2	1	3	3	1	2
2	Pharmaceutical Chemistry Practical II	3	2	2	2	2	2	2	1	1	1	1	3	2	2	2
2	Seminar / Assignment	3	3	2	3	2	2	2	3	1	2	3	1	1	2	3
3	Research Methodology and Biostatistics	2	3	3	3		3	3	2	2	2	2	2	3	3	3
3	Journal Club	3	3	3	3	3		2	3			3	3		3	3
3	Group Project	3	3	3	3	3	2	1	2	3	1	2	3	3	2	1
3	Discussion / Presentation (Proposal Presentation)	3	3	3	2	3	3	2	3	3	2	3	3	3	3	2
3	Research Work	3	2	2	2	1	1	2	2	2	1	3	1	2	1	2
4	Journal Club	3	3	3	3	3		2	3			3	3		3	3
4	Discussion /Presentation	2	3	3	3	2	2	1	3	1	1	2	3	3	3	3
4	Research Work	3	2	2	2	1	1	2	2	2	1	3	1	2	1	2
4	Participation/Presentation in research forum: National / International Seminar, Conferences, Workshops	3	3	2	1	3	3	3	3	2	1	3	1	1	3	3
4	Publication: National / International Journals	3	2	1	2		1		3	1	2	2	2	2	1	2
4	Academic/Research award: State/National/International Agencies	3	3	3	1	1	1	1	3		1	1	3	1	3	3

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

28.Co-curricular Activities

Students are encouraged to take part in co-curricular activities like seminars, conferences, symposia, paper writing, attending industry exhibitions, project competitions and related activities for enhancing their knowledge and networking.

29. Cultural and Literary Activities

Annual cultural festivals are held to showcase the creative talents in students. They are involved in planning and organizing the activities.

30. Sports and Athletics

Students are encouraged to take part in sports and athletic events regularly. Annual sports meet will be held to demonstrate sportsmanship and competitive spirit.

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

RAMAIAH UNIVERSITY OF APPLIED SCIENCES

M.S. Ramaiah University of Applied Sciences

Course Specifications

M. Pharm in Pharmaceutical Chemistry

Programme Code: 057

Faculty of Pharmacy
Batch 2022-2024

M.S. Ramaiah University of Applied Sciences * Bangalore - 560054 *

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

SEMESTER - I

Course Specifications: Modern Pharmaceutical Analytical Techniques (Theory)

Course Title	Modern Pharmaceutical Analytical Techniques (Theory)
Course Code	PCF501
Course Type	Core Theory Course
Department	Pharmaceutical Chemistry
Faculty	Pharmacy

1. Course Summary

The aim of this course is to impart knowledge and to familiarize the students with the principles, instrumentation and applications of UV-visible, IR, NMR, and Mass spectroscopy, as well as thermo-analytical techniques and X-ray crystallography in the analysis of various drugs and pharmaceuticals. The course also emphasizes the chromatographic and electrophoretic separation techniques.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	4:0:0
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Pharmaceutical Chemistry
Total Course Marks	100 **Component 1: 25 Marks** 1A: Attendance: 8 Marks 1B: Student-Teacher interaction: 2 Marks 1C: Sessional Exam: 15 Marks **Component 2 (SEE):** Semester End Examination: 75 Marks
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-1.** Summarize the fundamental principles, theory, and applications of UV-visible and IR spectroscopy, fluorimetric analysis, flame emission and atomic absorption spectroscopy
- **CO-2.** Theory, instrumentation and applications of NMR and Mass spectroscopy,
- **CO-3.** Explain the principles and applications of chromatographic, and electrophoretic separation techniques
- **CO-4.** Elaborate the principle and applications of potentiometric methods, X-ray crystallographic methods and thermo-analytical methods
- **CO-5.** Discuss the instrumentation of the various modern analytical techniques

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

4. Course Contents

Unit 1 **10 hours**

a. UV-Visible spectroscopy:

Introduction, Theory, Laws, and Instrumentation associated with UV-Visible spectroscopy, Choice of solvents and solvent effect and Applications of UV-Visible spectroscopy, Difference/ Derivative spectroscopy.

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, Data Interpretation.

c. Spectro flourimetry:

Theory of Fluorescence, Factors affecting fluorescence (Characteristics of drugs that can be analyzed by fluorimetry), Quenchers, Instrumentation and Applications of fluorescence spectrophotometer.

d. Flame emission spectroscopy and atomic absorption spectroscopy:

Principle, Instrumentation, Interferences and Applications.

Unit 2 **10 hours**

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 ^{13}C NMR. Applications of NMR spectroscopy

Unit 3 **10 hours**

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.

Unit 4 **10 hours**

Chromatography:

Principle, apparatus, instrumentation, chromatographic parameters, factors affecting resolution, isolation of drug from excipients, data interpretation and applications of the following:

a) Thin Layer chromatography) High-Performance Thin Layer Chromatography, c) Ion exchange chromatography d) Column chromatography, e) Gas chromatography, f) High-Performance Liquid chromatography, g) Ultra High-Performance Liquid chromatography, h) Affinity chromatography, i) Gel Chromatography

Unit 5 **10 hours**

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.

b. X ray Crystallography:
Production of X-rays, Different X-ray methods, Bragg 's law, Rotating crystal technique, X-ray powder technique, Types of crystals, and applications of X-ray diffraction.

Unit 6 **10 hours**

a. Potentiometry:
Principle, working, Ion selective Electrodes and Application of potentiometry.

b. Thermal Techniques:
Principle, thermal transitions and Instrumentation (Heat flux and power-compensation and designs), Modulated DSC, Hyper DSC, experimental parameters (sample preparation, experimental conditions, calibration, heating and cooling rates, resolution, source of errors) and their influence, advantage and disadvantages, pharmaceutical applications.
Differential Thermal Analysis (DTA): Principle, instrumentation and advantage and disadvantages, pharmaceutical applications, derivative differential thermal analysis (DDTA). TGA: Principle, instrumentation, factors affecting results, advantage and disadvantages, pharmaceutical applications.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)											Programme Specific Outcomes (PSOs)			
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PSO-1	PSO-2	PSO-3	PSO-4
CO-1	3		2	2		1		1			1	3	1		
CO-2	3			2		1		1			1	3	2		
CO-3	3		2	2		1		1			1	3	2		1
CO-4	3		1	2		1		1			1	3	2		1
CO-5	3		1	2				1			1	3	2		1
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution															

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		55
Demonstrations		02
1. Demonstration using Videos	2	
2. Demonstration using Physical Models / Systems		
3. Demonstration on a Computer		
Tutorials		00
Practical Work		
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		03
1. Case Study Presentation	00	
2. Guest Lecture	01	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	01	
5. Group Discussions	01	
6. Discussing Possible Innovations	00	
Written Examination		5
Total Duration in Hours		**65**

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the M. Pharm Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2 or SC3), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation				
	Component 1: CE (25% Weightage)			Component 2: SEE (75% Weightage)
Subcomponent	SC1	SC2	SC3	
Subcomponent Type	Attendance	Student – Teacher Interaction	Sessional Exam	Semester End Examination 75 Marks
Maximum Marks	8	2	15	
CO-1			X	X
CO-2			X	X
CO-3			X	X
CO-4			X	X
CO-5			X	
The details of SC1, SC2, SC3 are presented in the Programme Specifications Document.				

Component - 1: 25 marks

The marks allocated for Continuous mode of internal assessment shall be awarded as per the scheme given below:

Criteria	Maximum Marks
Attendance*	8
Student-Teacher Interaction	2
Total	10

1A. Guidelines for the allotment of marks for attendance*

Percentage of Attendance Theory	Marks
95 – 100	8
90 – 94	6
85 – 89	4
80 – 84	2
Less than 80	0

1B. Student-Teacher interaction: 2 marks

The student-staff interaction during the semester will be evaluated

1C. Sessional exam: Two sessional exams (each for 30 marks) of 1 hour duration will be conducted, one at the end of 6th week and the other at the end of the 12th week. The average of the 2 sessional marks reduced to 15 will be the marks scored in the Sessional Examination

Component - 2: 75 marks

A 3-hour duration Semester End Examination will be conducted for maximum marks of 75.
Both components will be evaluated by the concerned course leader/s.

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Re-assessment

1. A student who fails to secure a minimum 50% in component-1 and 2 put together will be asked to register for Supplementary examination.
2. A student who has not satisfied the attendance requirement (not eligible for SEE) shall have to appear for Supplementary examination.
3. The maximum number of such opportunities is limited and as per the academic regulations governing this Programme.

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Class room lectures, Assignments
2.	Understanding	Class room lectures, Assignments
3.	Critical Skills	Class room lectures, Student-Teacher interaction, Assignments
4.	Analytical Skills	Student-Teacher Interaction
5.	Problem Solving Skills	Class room lectures, Examination and Assignments
6.	Practical Skills	--
7.	Group Work	Assignments
8.	Self-Learning	Assignment
9.	Written Communication Skills	Assignment, Examination, Student-Teacher Interaction
10.	Verbal Communication Skills	Presentations, Student-Teacher Interaction
11.	Presentation Skills	Class room activity, Assignment, Examination
12.	Behavioral Skills	Course work
13.	Information Management	Group discussions and presentations, preparation for examination and presentations
14.	Personal Management	Course work
15.	Leadership Skills	Handling questions during presentations, classroom behavior with peers, Student-Teacher interaction

9. Course Resources

a. **Class Notes**

b. **Essential Reading**

1. Silverstein, RM. Webster, FX (2004) Spectrometric identification of organic compounds,6th Edition, New York: John Wiley and Sons.
2. Mendham, J. Denny, RC. Barnes, JD. Thomas, M. (2008). Vogel's Textbook of quantitative chemical analysis. 6th Edition, New Delhi: Dorling Kindersley (India) Pvt. Ltd., Licensees of Pearson Education in South Asia.
3. Willard, HH. Merritt, LL. Dean, JA. Settle, FA. Instrumental methods of analysis.7th Edition, New Delhi: CBS Publishers and Distributors.

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

4. Beckett, AH. Stenlake, JB. (2004) Practical Pharmaceutical Chemistry. Vol. I & II. London: The Athlon Press of the University of London.
5. Kemp, W. (2008) Organic spectroscopy. 3rd Edition. New York: Palgrave.
6. Skoog, DA. West, DM. Hollen, FG. Fundamentals of Analytical chemistry, 6th Edition, USA: Saunders college publishing.
7. Munson, JW. (2001) Pharmaceutical analysis- Modern methods-Part B. Vol II Marcel Dekker series. Mumbai, India: International Medical Book Distributors.
8. Sethi, PD. (1997) Quantitative Analysis of Drugs in Pharmaceutical formulation 3rd Edition, New Delhi: CBS Publishers.
9. Connors, KA. (1982) A textbook of pharmaceutical analysis. 3rd Edition, New York: John Wiley and sons.

c. Recommended Reading

1. Hoffmann, ED. Stroobant, V. (2001) Mass spectrometry: Principles and Applications. 2nd Ed. England: John Wiley and Sons Ltd.
2. Troy, D.B & Beringer, P. (2006) Remington's: The Science and Practice of Pharmacy. 22nd edition. New York: Lipincott Williams and Wilkins.
3. United State of Pharmacopeial Convention, (2004). The United States Pharmacopoeia-27 (NF-22). Rockville: MD
4. Government of India, (2014) Indian Pharmacopoeia. New Delhi: Government of India.

d. Magazines and Journals

1. Indian Journal of Chemistry Section – B: Published by National Institute of Science Communication and Information Resources, Dr K S Krishnan Marg, New Delhi 110 012
2. Indian Journal of Pharmaceutical Sciences: Published on behalf of Indian Pharmaceutical Association by OMICS International, Hyderabad, India

e. Websites

1. www.sciencedirect.com
2. www.elsevier.com
3. www.pubmed.com

M.S. Ramaiah University of Applied Sciences Bangalore - 560054

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Course Specifications: Advanced Organic Chemistry-I (Theory)

Course Title	Advanced Organic Chemistry-I (Theory)
Course Code	PCC502
Course Type	Core Theory Course
Department	Pharmaceutical Chemistry
Faculty	Pharmacy

1. Course Summary

This course is to provide in-depth knowledge of advances in organic chemistry, different techniques of organic synthesis and their applications to process chemistry as well as drug discovery. This course also emphasizes on the strategies as synthon approach and retro-synthesis.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	4:0:0
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Pharmaceutical Chemistry
Total Course Marks	100 **Component 1: 25 Marks** 1A: Attendance: 8 Marks 1B: Student-Teacher interaction: 2 Marks 1C: Sessional Exam: 15 Marks **Component 2 (SEE):** Semester End Examination: 75 Marks
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO-1. Summarize the formation, reactivity, stability and applications of various organic reactions and reaction intermediates
CO-2. Explain the mechanisms involved and applications of selected name reactions
CO-3. Appraise the constitution and utility of chosen synthetic reagents
CO-4. Discuss the synthesis of representative drugs containing heterocyclic nucleuses
CO-5. Analyze the principles, guidelines of synthon approach and retro-synthesis
CO-6. Design and strategize the synthesis of specific organic compounds along with mechanism, reactivity, stability and possible applications

M.S. Ramaiah University of Applied Sciences

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

4. Course Contents

Unit 1

Basic Aspects of Organic Chemistry:

a. Organic intermediates: Carbocations, carbanions, free radicals, carbenes and nitrenes. Their method of formation, stability and synthetic applications.

b. Types of reaction mechanisms and methods of determining them

c. Detailed knowledge regarding the reactions; mechanisms and their relative reactivity and orientations.

a. Addition reactions
b. Nucleophilic uni- and bimolecular reactions (SN1 and SN2)
c. Elimination reactions (E1 & E2; Hoffman & Saytzeff's rule)
d. Rearrangement reactions

12 hours

Unit 2

Study of mechanism and synthetic applications of following name Reactions:

Ugi reaction, Brook rearrangement, Ullmann coupling reactions, Dieckmann Reaction, Doebner- Miller Reaction, Sandmeyer Reaction, Mitsunobu reaction, Mannich reaction, Vilsmeyer-Haack Reaction, Sharpless asymmetric epoxidation, Baeyer-Villiger oxidation, Shapiro & Suzuki reaction, Ozonolysis and Michael addition reaction

12 hours

Unit 3

Synthetic Reagents & Applications:

Aluminium isopropoxide, N-bromosuccinamide, diazomethane, dicyclohexylcarbodimide, Wilkinson reagent, Witting reagent.

Osmium tetroxide, titanium chloride, diazopropane, diethyl azodicarboxylate, Triphenylphosphine, Benzotriazol-1-yloxy) tris (dimethylamino) phosphonium hexafluoro-phosphate (BOP).

Protecting groups

a. Role of protection in organic synthesis

b. Protection for the hydroxyl group, including 1, 2-and1, 3-diols: ethers, esters, carbonates, cyclic acetals & ketals

c. Protection for the Carbonyl Group: Acetals and Ketals

d. Protection for the Carboxyl Group: amides and hydrazides, esters

e. Protection for the Amino Group and Amino acids: carbamates and amides

12 hours

Unit 4

Heterocyclic Chemistry:

Organic Name reactions with their respective mechanism and application involved in synthesis of drugs containing five, six membered and fused heterocyclic such as Debus-Radziszewski imidazole synthesis, Knorr Pyrazole Synthesis Pinner Pyrimidine Synthesis, Combes Quinoline Synthesis, Bernthsen Acridine Synthesis, Smiles rearrangement and Traube purine synthesis.

Synthesis of few representative drugs containing these heterocyclic nucleus such as Ketoconazole, Metronidazole, Miconazole, celecoxib, antipyrin, Metamizole sodium, Terconazole, Alprazolam, Triamterene, Sulfamerazine, Trimethoprim, Hydroxychloroquine, Quinine, Chloroquine, Quinacrine, Amsacrine, Prochlorpherazine, Promazine, Chlorpromazine, Theophylline , Mercaptopurine and Thioguanine.

12 hours

Unit 5

Synthon approach and retrosynthesis applications

i. Basic principles, terminologies and advantages of retrosynthesis; guidelines for dissection of molecules. Functional group inter- conversion and addition (FGI and FGA)

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

ii. C-X disconnections; C-C disconnections – alcohols and carbonyl compounds; 1,2-, 1,3-,1,4-, 1,5-, 1,6-difunctionalized compounds
iii. Strategies for synthesis of three, four, five and six-membered ring.

12 hours

(Practical/Laboratory content: Selected experiments pertaining to this course were dealt in the course "Pharmaceutical Chemistry Practical - I
PCL505")

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)											Programme Specific Outcomes (PSOs)			
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PSO-1	PSO-2	PSO-3	PSO-4
CO-1	3		1	2				1			1	3	1		
CO-2	3		2	2				1			1	3	2		1
CO-3	3		2	2				1			1	3	2		1
CO-4	3		1	2				1			1	3	3		2
CO-5	3		2	3				1			1	3	3		2
CO-6	3		2	2				1			1	3	3		2
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution															

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		50
Demonstrations		05
1. Demonstration using Videos	5	
2. Demonstration using Physical Models / Systems		
3. Demonstration on a Computer		
Tutorials		00
Practical Work		
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		05
1. Case Study Presentation	00	
2. Guest Lecture	01	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	01	
5. Group Discussions	02	
6. Discussing Possible Innovations	01	
Written Examination		5
Total Duration in Hours		**65**

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the M. Pharm Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2 or SC3), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation				
	Component 1: CE (25% Weightage)			Component 2: SEE (75% Weightage)
Subcomponent ▶	SC1	SC2	SC3	
Subcomponent Type ▶	Attendance	Student – Teacher Interaction	Sessional Exam	Semester End Examination 75 Marks
Maximum Marks ▶	8	2	15	
CO-1		x	x	x
CO-2		x	x	x
CO-3		x	x	x
CO-4		x	x	x
CO-5		x	x	x
CO-6		x	x	x
The details of SC1, SC2, SC3 are presented in the Programme Specifications Document.				

Component - 1: 25 marks

The marks allocated for Continuous mode of internal assessment shall be awarded as per the scheme given below:

Criteria	Maximum Marks
Attendance*	8
Student-Teacher Interaction	2
Total	10

1A. Guidelines for the allotment of marks for attendance*

Percentage of Attendance Theory	Marks
95 – 100	8
90 – 94	6
85 – 89	4
80 – 84	2
Less than 80	0

1B. Student-Teacher interaction: 02 marks

1C. Sessional exam: Two sessional exams (each for 30 marks) of 1 hour duration will be conducted, one at the end of 6th week and the other at the end of the 12th week. The average of the 2 sessional marks reduced to 15 will be the marks scored in the Sessional Examination

Component - 2: 75 marks

A 3-hour duration Semester End Examination will be conducted for maximum marks of 75. Both components will be evaluated by concerned course leader/s.

Re-assessment

1. A student who fails to secure a minimum 50% in component-1 and 2 put together will be asked to register for Supplementary examination.
2. A student who has not satisfied the attendance requirement (not eligible for SEE) shall have to appear for Supplementary examination.
3. The maximum number of such opportunities is limited and as per the academic regulations governing this Programme.

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Class room lectures, Assignments
2.	Understanding	Class room lectures, Assignments
3.	Critical Skills	Class room lectures, Student-Teacher interaction, Assignments
4.	Analytical Skills	Student-Teacher Interaction
5.	Problem Solving Skills	Class room lectures, Examination and Assignments
6.	Practical Skills	--
7.	Group Work	Assignments
8.	Self-Learning	Assignment
9.	Written Communication Skills	Assignment, Examination, Student-Teacher Interaction
10.	Verbal Communication Skills	Presentations, Student-Teacher Interaction
11.	Presentation Skills	Class room activity, Assignment, Examination
12.	Behavioral Skills	Course work
13.	Information Management	Group discussions and presentations, preparation for examination and presentations
14.	Personal Management	Course work
15.	Leadership Skills	Handling questions during presentations, classroom behavior with peers, Student-Teacher interaction

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

9. Course Resources

a. Class Notes

b. Essential Reading

1. March, J. (1992) *Advanced Organic Chemistry*. 4th Ed. Singapore: Wiley Inter science publication.
2. Gould, ES. Rinchart, H and Winston. (1962) *Mechanism and Structure in Organic Chemistry*. New York: Holt Inc.
3. Clayden. Greeves. Warren and Woihers. (2001) *Organic Chemistry*. UK: Oxford University Press.
4. Finar, I. L. (1963) *Organic Chemistry Fundamental Principles*. Vol-I & II, 4th Ed, London: ELBS,Longman.
5. Sykes, P. (1981) *A Guide Book to Mechanism in Organic Chemistry*. 5th Edition, New Delhi: Orient Longman Limited.
6. Tandom and Gowel. *Reactive Intermediates in Organic Chemistry*. UK: Oxford & IBH Publishers.
7. Wilson, S.R. and Czarnik, A. W. (1997*) Combinatorial Chemistry- Synthesis and Applications*. New York: John Wiley and Sons
8. Carey. F.A. (1992) *"Organic Chemistry"*, 5th Ed. New Delhi: *Viva Books*
9. Warren, S. Wyatt, P. (2008) *Organic Synthesis: the disconnection approach*, 2nd Ed. New York: Wiley, Blackwell.
10. Norman, R., Coxon, J. (1993) *Principles of Organic Synthesis*. 3rd Ed. Lincoln, UK: Nelson Thornes Ltd.

c. Recommended Reading

1. Ahluwalia VK and Agarwal R. (2001) *Organic Synthesis - Special Techniques*. New Delhi: Narosa Publishers.
2. Ahluwalia VK and Parashar RK. (2016) *Organic Reaction Mechanisms*. 4th Ed. New Delhi: Narosa Publishers.

d. Magazines and Journals

1. Indian Journal of Chemistry Section – B: Published by National Institute of Science Communication and Information Resources, Dr K S Krishnan Marg, New Delhi 110 012
2. Indian Journal of Pharmaceutical Sciences: Published on behalf of Indian Pharmaceutical Association by OMICS International, Hyderabad, India

e. Websites

1. www.sciencedirect.com
2. www.elsevier.com

M.S. Ramaiah University of Applied Sciences

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

Course Specifications: Advanced Medicinal Chemistry (Theory)

Course Title	Advanced Medicinal Chemistry (Theory)
Course Code	PCC503
Course Type	Core Theory Course
Department	Pharmaceutical Chemistry
Faculty	Pharmacy

1. Course Summary

The aim of this course is to impart knowledge in the area of medicinal chemistry at molecular level including different techniques for rational drug design. This knowledge helps the PG students to take up research projects in R&D wings of pharmaceutical industry as well as at academic Institutions. The study also includes process of drug design by different strategies, highlights the importance of stereochemistry in drug discovery, advanced strategies like peptido-mimetics.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	4:0:0
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Pharmaceutical Chemistry
Total Course Marks	100 **Component 1: 25 Marks** 1A: Attendance: 8 Marks 1B: Student-Teacher interaction: 2 Marks 1C: Sessional Exam: 15 Marks **Component 2 (SEE):** Semester End Examination: 75 Marks
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-1.** Summarize the different stages of drug discovery
- **CO-2.** Outline the concepts of drug development like stereochemistry, enzyme inhibitors, prodrugs and analogue design, combating multidrug resistance
- **CO-3.** Discuss the medicinal chemistry aspects of drugs acting on CNS and CVS
- **CO-4.** Discuss the chemistry, MOA, Synthesis and SAR of new generation molecules of anticancer and antiviral agents
- **CO-5.** Recognize the design strategies and therapeutic potential of peptidomimetics
- **CO-6.** Develop strategies for design and development of new drug molecules

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

4. Course Contents

Unit 1

Drug discovery: Stages of drug discovery, lead discovery; identification, validation and diversity of drug targets. Biological drug targets: Receptors, types, binding and activation, theories of drug receptor interaction, drug receptor interactions, agonists vs antagonists, artificial enzymes.

12 hours

Unit 2

Prodrug Design and Analog design:

Prodrug design: Basic concept, Carrier linked prodrugs/Bioprecursors, Prodrugs of functional group, Prodrugs to improve patient acceptability, Drug solubility, Drug absorption and distribution, site specific drug delivery and sustained drug action. Rationale of prodrug design and practical consideration of prodrug design.

Combating drug resistance: Causes for drug resistance, strategies to combat drug resistance in antibiotics and anticancer therapy, Genetic principles of drug resistance.

Analog Design: Introduction, Classical & Non classical, Bioisosteric replacement strategies, rigid analogs, alteration of chain branching, changes in ring size, ring position isomers, design of stereo isomers and geometric isomers, fragments of a lead molecule, variation in inter atomic distance.

12 hours

Unit 3

Medicinal chemistry aspects of the following classes of drugs

Systematic study, SAR, Mechanism of action and synthesis of new generation molecules of following class of drugs: Anti-hypertensive drugs, Psychoactive drugs, Anticonvulsant drugs, H1 & H2 receptor antagonist, COX1 & COX2 inhibitors, Adrenergic & Cholinergic agents, Antineoplastic and Antiviral agents.

Stereochemistry and Drug action: Realization that stereo selectivity is a pre-requisite for evolution. Role of chirality in selective and specific therapeutic agents. Case studies, Enantio selectivity in drug adsorption, metabolism, distribution and elimination.

12 hours

Unit 4

Rational Design of Enzyme Inhibitors

Enzyme kinetics & Principles of Enzyme inhibitors, Enzyme inhibitors in medicine, Enzyme inhibitors in basic research, rational design of non-covalently and covalently binding enzyme inhibitors.

12 hours

Unit 5

Peptidomimetics

Therapeutic values of Peptidomimetics, design of peptidomimetics by manipulation of the amino acids, modification of the peptide backbone, incorporating conformational constraints locally or globally. Chemistry of prostaglandins, leukotrienes and thromboxones.

12 hours

(Practical/Laboratory content (please mention if Lab content doesn't exist for this course): Selected experiments pertaining to this course were dealt in the course "Pharmaceutical Chemistry Practical - PCL505")

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)											Program Educational Objectives (PEOs)			
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PEO-1	PEO-2	PEO-3	PEO-4
CO-1	3	1	2	1			1	1		1	2	3	1		1
CO-2	3	3	3	2			1	1			2	3	3		1
CO-3	3	1	1					2			1	3	1		
CO-4	3	1	1					2			1	3	1		
CO-5	3	3	3	2			1	1			2	3	3		2
CO-6	3	3	3	3			1	1		1	3	3	3		2
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution															

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		50
Demonstrations		05
1. Demonstration using Videos	5	
2. Demonstration using Physical Models / Systems		
3. Demonstration on a Computer		
Tutorials		00
Practical Work		
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		05
1. Case Study Presentation	00	
2. Guest Lecture	01	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	01	
5. Group Discussions	02	
6. Discussing Possible Innovations	01	
Written Examination		5
Total Duration in Hours		**65**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the M. Pharm Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2 or SC3), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation				
	Component 1: CE (25% Weightage)			Component 2: SEE (75% Weightage)
Subcomponent ▶	SC1	SC2	SC3	
Subcomponent Type ▶	Attendance	Student – Teacher Interaction	Sessional Exam	Semester End Examination 75 Marks
Maximum Marks ▶	8	2	15	
CO-1		×	×	×
CO-2		×	×	×
CO-3		×	×	×
CO-4		×	×	×
CO-5		×	×	×
CO-6				×
The details of SC1, SC2, SC3 are presented in the Programme Specifications Document.				

Component - 1: 25 marks

The marks allocated for Continuous mode of internal assessment shall be awarded as per the scheme given below:

Criteria	Maximum Marks
Attendance*	8
Student-Teacher Interaction	2
Total	10

1A. Guidelines for the allotment of marks for attendance*

Percentage of Attendance Theory	Marks
95 – 100	8
90 – 94	6
85 – 89	4
80 – 84	2
Less than 80	0

1B. Student-Teacher interaction

1C. Sessional exam: Two sessional exams (each for 30 marks) of 1 hour duration will be conducted, one at the end of 6th week and the other at the end of the 12th week. The average of the 2 sessional marks reduced to 15 will be the marks scored in the Sessional Examination

Component - 2: 75 marks

A 3-hour duration Semester End Examination will be conducted for maximum marks of 75. Both components will be evaluated by the concerned course leader/s.

Re-assessment

1. A student who fails to secure a minimum 50% in component-1 and 2 put together will be asked to register for Supplementary examination.

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

2. A student who has not satisfied the attendance requirement (not eligible for SEE) shall have to appear for Supplementary examination.
3. The maximum number of such opportunities are limited and as per the academic regulations governing this Programme.

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Class room lectures, Assignments
2.	Understanding	Class room lectures, Assignments
3.	Critical Skills	Class room lectures, Student-Teacher interaction, Assignments
4.	Analytical Skills	Student-Teacher Interaction
5.	Problem Solving Skills	Class room lectures, Examination and Assignments
6.	Practical Skills	--
7.	Group Work	Assignments
8.	Self-Learning	Assignment
9.	Written Communication Skills	Assignment, Examination, Student-Teacher Interaction
10.	Verbal Communication Skills	Presentations, Student-Teacher Interaction
11.	Presentation Skills	Class room activity, Assignment, Examination
12.	Behavioral Skills	Course work
13.	Information Management	Group discussions and presentations, preparation for examination and presentations
14.	Personal Management	Course work
15.	Leadership Skills	Handling questions during presentations, class room behavior with peers, Student-Teacher interaction

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

9. Course Resources

a. Class Notes

b. Essential Reading

1. Smith HJ, Williams DR. (2006). Smith and Williams' Introduction to the principles of Drug design and action. 4th Edition. USA: CRC Press Taylor &Francis
2. Thomas G. (2000). Medicinal Chemistry: An Introduction. UK: John Wiley & sons Ltd.
3. Doerge R F (ed.) (1982) Wilson and Gisvold's Text book of Organic Medicinal and Pharmaceutical chemistry.8th Edition. Toranto: Lippincott
4. Williams DA. (ed.) (2002) Foye's Principles of Medicinal Chemistry. 5th Edition. Philadelphia: Lippincott
5. Patrick G L. (2001). An Introduction to Medicinal chemistry. 2nd Edition. New York: Oxford
6. Abraham DJ (ed.) (2003). Burger's Medicinal chemistry and Drug Discovery Vol. 1 to 6. 5th Edition. New York: John Wiley & Sons
7. Hansch C. (ed.) (1990). Comprehensive Medicinal Chemistry Vol.1 to 6, UK: Pergamon Press
8. Peptidomimetics in Organic and Medicinal Chemistry by Antonio Guarna and Andrea Trabocchi, First edition, Wiley's publishers.

c. Recommended Reading

1. United State of Pharmacopeial Convention, (2004) The United States Pharmacopoeia-27 (NF-22). Rockville: MD
2. Silverman R B. (2004). The organic chemistry of Drug design and action. 2nd Edition. India: Elsevier
3. Government of India, (2014) Indian Pharmacopoeia. New Delhi: Government of India.
4. Computational and structural approaches to drug design edited by Robert M Stroud and Janet. F Moore
5. Principles of Medicinal Chemistry by William Foye, 7th Edition, lippincott Williams & Wilkins, Woltess Kluwer (India) Pvt.Ltd, New Delhi.

d. Magazines and Journals

1. Indian Journal of Chemistry Section – B, New Delhi, National Institute of Science Communication and Information Resources, CSIR
2. Indian Journal of Pharmaceutical Sciences, Mumbai, Indian Pharmaceutical Association
3. Asian Journal of Chemistry, Ghaziabad, Asian Publication Corporation

e. Websites

1. www.sciencedirect.com
2. www.rsc.org
3. www.chemtube3d.com
4. www.pubmed.com

M.S. Ramaiah University of Applied Sciences * Bangalore - 560054 *

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Course Specifications: Chemistry of Natural Products (Theory)

Course Title	Chemistry of Natural Products (Theory)
Course Code	PCC504
Course Type	Core Theory Course
Department	Pharmaceutical Chemistry
Faculty	Pharmacy

1. Course Summary

The aim of this course is to provide detailed knowledge of chemistry of medicinal compounds obtained from natural sources and chemical approaches followed for structural elucidation. The course also emphasizes on spectral characterization of medicinal compounds of natural origin and recombinant DNA technology.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture:Tutorial:Practical)	4:0:0
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Pharmaceutical Chemistry
Total Course Marks	100 **Component 1: 25 Marks** 1A: Attendance: 8 Marks 1B: Student-Teacher interaction: 2 Marks 1C: Sessional Exam: 15 Marks **Component 2 (SEE):** Semester End Examination: 75 Marks
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-1.** Analyze the importance of natural compounds as lead molecules for new drug discovery
- **CO-2.** Discuss the different types of natural compounds and their chemistry with emphasis on their medicinal importance
- **CO-3.** Illustrate chemical methods for structural elucidation of compounds from natural origin
- **CO-4.** Summarize the isolation, purification and characterization methods of active phytoconstituents from natural source
- **CO-5.** Compile the recent trends and advances/development in chemistry of natural products
- **CO-6.** Develop the concept of rDNA technology tool for new drug discovery

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

Dean Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

4. Course Contents

Unit 1

Study of Natural products as leads for new pharmaceuticals for the following classes of drugs

a) Drugs Affecting the Central Nervous System: Morphine Alkaloids
b) Anticancer Drugs: Paclitaxel and Docetaxel, Etoposide, and Teniposide
c) Cardiovascular Drugs: Lovastatin, Teprotide and Dicoumarol
d) Neuromuscular Blocking Drugs: Curare alkaloids
e) Anti-malarial drugs and Analogues
f) Chemistry of macrolid antibiotics (Erythromycin, Azithromycin, Roxithromycin, and Clarithromycin) and β -Lactam antibiotics (Cephalosporins and Carbapenem)

12 hours

Unit 2

a) Alkaloids

General introduction, classification, isolation, purification, molecular modification and biological activity of alkaloids, general methods of structural determination of alkaloids, structural elucidation and stereochemistry of ephedrine, morphine, ergot, emetine and reserpine.

b) Flavonoids

Introduction, isolation and purification of flavonoids, General methods of structural determination of flavonoids; Structural elucidation of quercetin.

c) Steroids

General introduction, chemistry of sterols, sapogenin and cardiac glycosides. Stereochemistry and nomenclature of steroids, chemistry of contraceptive agent's male & female sex hormones (Testosterone, Estradiol, Progesterone), adrenocorticoids (Cortisone), contraceptive agents and steroids (Vit – D).

12 hours

Unit 3

a) Terpenoids

Classification, isolation, isoprene rule and general methods of structural elucidation of Terpenoids; Structural elucidation of drugs belonging to mono (citral, menthol, camphor), di (retinol, Phytol, taxol) and tri terpenoids (Squalene, Ginsenoside) carotinoids (β carotene).

b) Vitamins

Chemistry and physiological significance of Vitamin A, B1, B2, B12, C, E, Folic acid and Niacin.

12 hours

Unit 4

a) Recombinant DNA technology and drug discovery

rDNA technology, hybridoma technology, new pharmaceuticals derived from biotechnology; Oligonucleotide therapy.
Gene therapy: Introduction, Clinical application and recent advances in gene therapy, principles of RNA & DNA estimation

b) Active constituent of certain crude drugs used in Indigenous system

Diabetic therapy –*Gymnemasylvestre, Salacia reticulate, Pterocarpusmarsupiam, Swertiachirata, Trigonellafoenumgraccum;*
Liver dysfunction – *Phyllanthusniruri;*
Antitumor – *Curcuma longa Linn*

12 hours

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Unit 5

Structural Characterization of natural compounds

Structural characterization of natural compounds using IR, 1HNMR, 13CNMR and MS Spectroscopy of specific drugs e.g., Penicillin, Morphine, Camphor, Vit-D, Quercetin and Digitalis glycosides

12 hours

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)											Programme Specific Outcomes (PSOs)			
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PSO-1	PSO-2	PSO-3	PSO-4
CO-1	3		3	3			2	2		2	2	3	3	3	3
CO-2	3	1	2	2			2	2			2	3	3	2	3
CO-3	3		2	2				2		2	2	3	3	2	1
CO-4	3	2	3	3			2	2		2	2	3	3	2	3
CO-5	3	2	2	2			2	2		2	2	3	3	2	2
CO-6	3	2	3	3			2	2		2	2	3	3	2	2
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution															

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		50
Demonstrations		05
1.Demonstration using Videos	02	
2. Demonstration using Physical Models / Systems	03	
3. Demonstration on a Computer		
Tutorials		50
Practical Work		
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		05
1. Case Study Presentation	02	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	03	
6. Discussing Possible Innovations	00	
Written Examination		05
Total Duration in Hours		**65**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the M.Pharm Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2 or SC3), COs are assessed as illustrated in the following Table.

Focus of COson each Component or Subcomponent of Evaluation				
	Component 1: CE (25% Weightage)			Component 2: SEE (75% Weightage)
Subcomponent▶	SC1	SC2	SC3	
Subcomponent Type ▶	Attendance	Student – Teacher Interaction	Sessional Exam	Semester End Examination 75 Marks
Maximum Marks▶	8	2	15	
CO-1		X	X	X
CO-2		X	X	X
CO-3		X	X	X
CO-4		X	X	X
CO-5		X	X	X
CO-6			X	X
The details of SC1, SC2, SC3 are presented in the Programme Specifications Document.				

Component - 1: 25 marks

The marks allocated for Continuous mode of internal assessment shall be awarded as per the scheme given below:

Criteria	Maximum Marks
Attendance*	8
Student-Teacher Interaction	2
Total	10

1A. Guidelines for the allotment of marks for attendance*

Percentage of Attendance Theory	Marks
95 – 100	**8**
90 – 94	**6**
85 – 89	**4**
80 – 84	**2**
Less than 80	**0**

1B. Student-Teacher interaction

1C. Sessional exam: Two sessional exams (each for 30 marks) of 1 hour duration will be conducted, at the end of 6th week and the other at the end of the 12th week. The average of the 2 sessional marks reduced to 15 will be the marks scored in the Sessional Examination

Component - 2: 75 marks

A 3-hour duration Semester End Examination will be conducted for maximum marks of 75. Both components will be evaluated by concerned course leader/s.

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Re-assessment

1. A student who fails to secure a minimum 50% in component-1 and 2 put together will be asked to register for Supplementary examination.
2. A student, who has not satisfied the attendance requirement (not eligible for SEE) shall have to appear for Supplementary examination.
3. The maximum number of such opportunities are limited and as per the academic regulations governing this programme.

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Class room lectures, Assignments
2.	Understanding	Class room lectures, Assignments
3.	Critical Skills	Class room lectures, Student-Teacher interaction, Assignments
4.	Analytical Skills	Student-Teacher Interaction
5.	Problem Solving Skills	Class room lectures, Examination and Assignments
6.	Practical Skills	--
7.	Group Work	Assignments
8.	Self-Learning	Assignment
9.	Written Communication Skills	Assignment, Examination, Student-Teacher Interaction
10.	Verbal Communication Skills	Presentations, Student-Teacher Interaction
11.	Presentation Skills	Class room activity, Assignment, Examination
12.	Behavioral Skills	Course work
13.	Information Management	Group discussions and presentations, preparation for examination and presentations
14.	Personal Management	Course work
15.	Leadership Skills	Handling questions during presentations, class room behavior with peers, Student-Teacher interaction

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

9. Course Resources

a. Class Notes

b. Essential Reading

1. Finar, I.L. (2002) Stereochemistry and the Chemistry of Natural Products. 5thed.Vol. 2. India: Pearson education.
2. Hench, C. (2005) Comprehensive Medicinal Chemistry. 1sted. England: Pergamon Press.
3. Burger, A. (1998) Medicinal Chemistry and Drug Discovery. 6thed. New Jersey: John Wiley and sons Inc.
4. Vyas, S.P. Dixit VK. (2007). Pharmaceutical Biotechnology. 1sted. New Delhi: CBS
5. Paech. and Tracey M.V.(1956)Modern Methods of Plant Analysis. 1sted.Verlag, Berlin, Germany:
6. Heidelberg: Springer
7. 6. Lawrence, P and Miller (1993) Phytochemistry Vol. I and II. Van Nostrand Reinhold Co.
8. Jetter and Reinhard (2014) Recent advances in Phytochemistry.2014 Ed.Vol.I to IV – ScikelRuneckles, North America:Springer Science & Business Media.
9. Chemistry of natural products Vol I onwards IWPAC.
10. Nakanishi Gggolo Natural Product Chemistry California: University Science Books
11. Raphael and Ikan (2005) Natural Products "A laboratory guide" 2ndNew York: Academic Press.
12. Manske, R.H.P.(1960)The Alkaloid Chemistry and Physiology. New York: Academic
13. Chapman stall. Introduction to molecular Phytochemistry – CHJ Wells.
14. Gurdeep Chatwall (2002) Organic Chemistry of Natural Products. Vol I and II India: Himalaya Publishing House.
15. Agarwal, O.P. (2015) Organic Chemistry of Natural Products. 2015ed. Vol I and II India: Krishana Prakashan.
16. Gupta PK. (2004) Elements of Biotechnology. 1sted.India: Rastogi Publications.
17. Purohit,S.S.and Mathur S.K.(2002) Biotechnology: Fundamentals and Applications, 13th ed. India:Agro-Bios Publishers.
18. Harborne,I.B.(1998) Phytochemical methods-A guide to modern techniques of Plant Analysis.3rd Ed.London:Chapman and Hall

c. Recommended Reading

1. Williams DA. (ed.) (2002) Foye's Principles of Medicinal Chemistry.5th Edition. Philadelphia: Lippincott
2. Gringauz, A. (2010) Introduction to Medicinal Chemistry.2010ed. New York: Wiley-VC
3. Paul M. Dewick. (1998) Medicinal Natural Products (a biosynthetic approach). England: John Wiley andsons Ltd.

d. Magazines andJournals

1. Indian Journal of Chemistry Section – B, CSIR
2. Indian Journal of Heterocyclic Chemistry, National Academy of Chemistry
3. Indian Journal of Pharmaceutical Sciences IPA

e. Websites

1. www.sciencedirect.com
2. www.elsevier.com
3. www.pubchem.com

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Course Specifications: Pharmaceutical Chemistry practical- I (Practical)

Course Title	Pharmaceutical Chemistry practical- I (Practical)
Course Code	PCL505
Course Type	Core Practical Course
Department	Pharmaceutical Chemistry
Faculty	Pharmacy

1. Course Summary

The aim of the course is to impart training in the analytical method development using instruments like Spectrophotometer, HPLC, Gas Chromatography, Fluorimetry and Flame Photometry. To synthesis medicinally important compounds involving some name reactions and also, to characterize the synthesized compounds by using TLC, Melting point, IR spectroscopy and to analyze the natural products for their elements, functional groups and degradation products

2. Course Size and Credits:

Number of Credits	06
Credit Structure (Lecture: Tutorial: Practical)	0:0:12
Total Hours of Interaction	180
Number of Weeks in a Semester	15
Department Responsible	Pharmaceutical chemistry
Total Course Marks	150 **Component 1: CE:50 Marks** 1A. Attendance: 10 marks 1B. Practical Record & Viva-voce: 10 marks 1C. Sessional Examination: 30 Marks (Average of two) **Component 2:** Semester End Examination: 100 Marks
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-1.** Apply various instrumental analytical techniques to analyse pharmaceutical substances.
- **CO-2.** Apply the concepts of organic reactions for the synthesis of medicinally important compounds.
- **CO-3.** Select proper method of isolation of natural products and degradation of the same
- **CO-4.** Analyse organic compounds and characterize the same with different physical and chemical parameters.
- **CO-5.** Propose different purification methods for synthesized or isolated compounds.

M.S.Ramaiah University of Applied Sciences * Bangalore - 560054 *

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

4. Course Contents

1. Analysis of Pharmacopeial compounds and their formulations by UV Vis spectrophotometer, RNA & DNA estimation
2. Simultaneous estimation of multi component containing formulations by UV spectrophotometry
3. Experiments based on HPLC
4. Experiments based on Gas Chromatography
5. Estimation of riboflavin/quinine sulphate by fluorimetry
6. Estimation of sodium/potassium by flame photometry

To perform the following reactions of synthetic importance:

1. Purification of organic solvents, column chromatography
2. Claisen-schimidt reaction
3. Benzyllic acid rearrangement
4. Beckmann rearrangement
5. Hoffmann rearrangement
6. Mannich reaction
7. Synthesis of medicinally important compounds involving more than one step along with purification and Characterization using TLC, melting point and IR spectroscopy (4 experiments)
8. Estimation of elements and functional groups in organic natural compounds
9. Isolation, characterization like melting point, mixed melting point, molecular weight determination, functional group analysis, co-chromatographic technique for identification of isolated compounds and interpretation of UV and IR data.
10. Some typical degradation reactions to be carried on selected plant constituents

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)											Programme Specific Outcomes (PSOs)			
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PSO-1	PSO-2	PSO-3	PSO-4
CO-1	3	1	1	2			1	1			1	2			1
CO-2	3	2	1	2			1	1			1	2	2		1
CO-3	3	1	1	1				1			1	2	1		1
CO-4	3	1	1	2				1			1	2			
CO-5	3			1			2	1			1	2			
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution															

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		20
Demonstrations		07
1.Demonstration using Videos	7	
2. Demonstration using PhysicalModels / Systems		
3. Demonstration on a Computer		
Tutorials		
Practical Work		150
1. Course Laboratory	150	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		05
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	05	
6. Discussing Possible Innovations	00	
Laboratory Examinations		18
Total Duration in Hours		**200**

M.S. Ramaiah University of Applied Sciences * Bangalore - 560054 *

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the M. Pharm Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2 or SC3), COs are assessed as illustrated in the following Table.

Focus of Cos on each Component or Subcomponent of Evaluation				
	Component 1: CE (33.33% Weightage)			Component 2: SEE (66.66% Weightage)
Subcomponent▶	SC1	SC2	SC3	
Subcomponent Type ▶	Attendance	Practical Records, Regular viva voce	Sessional Exam	Semester End Examination 100 Marks
Maximum Marks▶	10	10	30	
CO-1		X	X	X
CO-2		X	X	X
CO-3		X	X	X
CO-4		X	X	X
CO-5		X	X	X
The details of SC1, SC2, SC3 are presented in the Programme Specifications Document.				

Component - 1: 50 marks

The marks allocated for Continuous mode of internal assessment shall be awarded as per the scheme given below:

Criteria	Maximum Marks
Attendance*	10
Practical Records, Regular viva voce	10
Total	20

1A. Guidelines for the allotment of marks for attendance*

Percentage of Attendance Theory	Marks
95 – 100	**10**
90 – 94	**7.5**
85 – 89	**5**
80 – 84	**2.5**
Less than 80	**0**

1B. Practical Records, Regular viva voce

1C. Sessional exam: Two sessional examinations (each for 30 Marks with six-hour duration) will be conducted. Average marks of the two sessionals will be computed for sessional examination marks.

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Component - 2: 100 marks
Practical Examination: A practical exam shall be conducted for maximum marks 100 Marks with six hours of duration. Component 2 will be evaluated by course leader and external examiner.

Re-assessment
1. A student who fails to secure a minimum 50% in component-1 and 2 put together will be asked to register for Supplementary examination.
2. A student who has not satisfied the attendance requirement (not eligible for SEE) shall have to appear for Supplementary examination.
3. The maximum number of such opportunities are limited and as per the academic regulations governing this Programme.

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S.No.	Curriculum and Capabilities Skills	How imparted during the course
1	Knowledge	Laboratory interactions and self-study
2	Understanding	Experiments conducted in laboratory
3	Critical Skills	Experiments conducted in laboratory
4	Analytical Skills	Inference of laboratory results
5	Problem Solving Skills	Lab work and Examination
6	Practical Skills	Face to face interactions and lab work
7	Group Work	Laboratory Tasks
8	Self-Learning	Practical Record writing and Examination
9	Written Communication Skills	Viva voce and presentation of results
10	Verbal Communication Skills	Presentation of results
11	Presentation Skills	Laboratory Tasks
12	Behavioral Skills	Practical Record writing and presentation of results
13	Information Management	Group discussions and planning of Laboratory Tasks
15	Leadership Skills	Presentation, Handling Questions during presentation, Interaction with peers

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

9. Course Resources

a. Essential Reading

1. Robert M Silverstein (2004), Spectrometric Identification of Organic compounds, 6thedn, John Wiley & Sons.
2. Doglas A Skoog, F. James Holler,Timothy A. Nieman (1998),Principles of Instrumental Analysis , 5thedn, Eastern press, Bangalore.
3. Willard, HH. Meritt, LL. Dean, JA. Settle, FA. (1984) Instrumental Methods of Analysis. 6th edn,. New Delhi: CBS Publishers
4. March J(2013). Advanced Organic chemistry, Reaction, Mechanisms and Structure.7thedn. John Wiley and Sons, New York.
5. Finar IL. (2002)Organic Chemistry Vol I and II. 6 th edn .ELBS, Pearson Education Ldts, Dorling Kindersley, India Pvt. Ltd.
6. Wilson and Gisvold's (2004).Text book of Organic Medicinal and Pharmaceutical Chemistry, 11th Edition, Lppincott Williams & Wilkins, Woltess Kluwer (India) Pvt.Ltd, New Delhi.
7. George Lunn. (1997).HPLC Methods for Recently Approved Pharmaceuticals, 1stedn.Published by Wiley.
8. Rapheal Khan. Natural Product Chemistry "A laboratory guide" 2ndedn. Academic Press, INC.
9. Phytochemical methods of Harborne, Springer, Netherlands.
10. Lednicer D, Mitscher LA (2007).The Organic Chemistry Of Drug Synthesis (Vol. I and II) 7 th volume USA: John Wiley-Inter science

b. Recommended Reading

1. The United States Pharmacopoeia-27 (NF-22).(2004) Rockville:MD, USA
2. Government of India, (2014) Indian Pharmacopoeia. Ministry of Health and Family Welfare, Government of India. New Delhi
3. Government of India, (2010) Indian Pharmacopoeia. Ministry of Health and Family Welfare, Government of India. New Delhi
4. Government of India, (1996) Indian Pharmacopoeia. Ministry of Health and Family Welfare, Government of India. New Delhi
5. Beckett and Stenlake, (1997) Practical Pharmaceutical Chemistry, Vol II, 4thEd, TheAthlone. Press, University of London, London
6. Gurdeep and Chatwall(1986).Organic Chemistry of Natural Products Vol I and II .Istedn. Himalaya Publishing House.
7. Agarwal .OP.(2010)Organic Chemistry of Natural Products Vol I and II by, Krishan Prakashan

c. Magazines and Journals

1. Journal of Biomedical Analysis, Elsevier, Science Direct, Amsterdam
2. Journal of Chromatography A, Elsevier, Science Direct, Amsterdam
3. Journal of heterocyclic Chemistry, Wiley Periodicals, Inc. Bengaluru
4. Journal of natural products, ACS Publications Washington DC
5. Asian Journal of Pharmaceutical Sciences, Elsevier, ScienceDirect, Amsterdam
6. Indian Journal of Pharmaceutical Sciences, Indian Pharmaceutical Association, Mumbai
7. Journal of Pharmaceutical and Biomedical Analysis, Science Direct, Amsterdam.

d. Websites

1. www.sciencedirect.com
2. www.pubmed.com
3. www.elsevier.com

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Course Specifications: Seminar/Assignment

Course Title	Seminar/Assignment
Course Code	PCS506
Department	Pharmaceutical Chemistry
Faculty	Pharmacy

1. Course Summary

The course aims to instill critical thinking, analytical thinking and problem-solving skills amongststudents. Students are trained to refer to literature and present their thought process, justification either in the form of an essay or debate as a concise report. Students are trained for collaborative learning while analyzing and also solving problems. They are exposed to citation, referencing and paraphrasing. Students are also exposed in communicating the collected information/literature to present and defend their accomplishment.

2. Course Size and Credits:

Number of credits	04
Total hours of class room and laboratory interaction during the course	105 hours in a semester
Total Course Marks	**100** **Component -1: Assignment = 60 Marks** Report evaluated individually for 15 marks for 4 theory Courses in the semester. **Component-2: Seminar = 40 Marks** Assignment presentation evaluated individually for 10 marks for 4 theory Courses in the semester.
Pass Criteria	As per the Academic Regulations
Attendance requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-1.** Develop critical thinking, analytical thinking and problem-solving skills
- **CO-2.** Demonstrate the ability to synthesise the report
- **CO-3.** Develop academic report with appropriate citation and referencing style
- **CO-4.** Communicate the contents of the report to the panel
- **CO-5.** Defend the contents of the report in the panel

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

4. Course Contents

Critical review of the literature on the given assignment
Writing and Communication skills
Citation and referencing styles- Harvard referencing style
Plagiarism review
Analytical and problem-solving skills
Practical/Laboratory content: NA

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)											Programme Specific Outcomes (PSOs)			
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PSO-1	PSO-2	PSO-3	PSO-4
CO-1	1	3	3	1	1	2		1		2	2	1	1	2	2
CO-2	2	3	2	2		1		3		2	1	1	1	2	3
CO-3	3	1	1	3	1	2		3	1		3	1	1		2
CO-4	1	2	2	3	2	2	2	3	1		3	1	1	2	2
CO-5	3		2	3		1	2	3		1	3	1	1	2	2
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution															

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration inHours
Face to Face Lectures		10
Demonstrations		10
1. Demonstration using Videos		
2. Demonstration using Physical Models/Systems	5	
3. Demonstration on a Computer	5	
Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		15
1. Course Laboratory	05	
2. Computer Laboratory	00	
3. Engineering Workshop/Course Workshop/Kitchen	10	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		50
1. Case Study Presentation	10	
2. Guest Lecture	00	
3. Industry/Field Visit	00	
4. Brain Storming Sessions	10	
5. Group Discussions		
6. Discussing Possible Innovations	30	
Term Tests, Laboratory Examination/Written Examination, Presentations		20
Total Duration in Hours		105

M.S. Ramaiah University of Applied Sciences * Bangalore - 560054 *

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the M. Pharm Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2 or SC3), COs are assessed as illustrated in the following Table.

	Component 1: Assignment (60% Weightage)	Component 2: Seminar (40% Weightage)
Subcomponent ▶	SC1	SC2
Subcomponent Type ▶	Assignment	Seminar
Maximum Marks ▶	60	40
CO-1	X	X
CO-2	X	X
CO-3	X	X
CO-4	X	X
CO-5		X

Component - 1: Assignment = 60 Marks [4 courses of 15 marks each]
One word processed assignment submitted for 4 theory courses in a semester will be evaluated by Course Leaders for a maximum of 15 marks each.

Component - 2: Seminar = 40 Marks [4 courses of 10 marks each]
Presentation on submitted assignments will be evaluated by Course Leaders for a maximum of 10 marks each.

Marks awarded for four individual Courses (Assignment -15 marks & Seminar – 10 marks) will be summed and calculated for the total marks obtained for a maximum mark of 100.

The assessment questions are set to test the learning outcomes. In each component a certain learning outcome are assessed. The following table illustrates the focus of learning outcome in each componentassessed:

Both components will be moderated by a second examiner.

Reassessment
1.If a student fails in the course, it is considered fail and he or she has to earn the credits inthe makeup opportunity and re-registration to the Course is required.

2.The maximum number of such opportunities is limited as per the academic regulationsgoverning this programme.

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

Dean - Academics
M.S. Ramaiah University of Applied Sciences

8. Achieving COs

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Reading and findings
2.	Understanding	Reading and findings
3.	Critical Skills	Literature Review
4.	Analytical Skills	Data collection
5.	Problem Solving Skills	Data analysis
6.	Practical Skills	Writing & Presentation
7.	Group Work	Data analysis
8.	Self-Learning	Reading and findings
9.	Written Communication Skills	Assignment processing
10.	Verbal Communication Skills	Presentation
11.	Presentation Skills	Presentation
12.	Behavioral Skills	Interactions
13.	Information Management	Paper writing
14.	Personal Management	Course work
15.	Leadership Skills	Effective management of learning, time management, achieving the learning

M.S. Ramaiah University of Applied Sciences * Bangalore - 560054 *

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

9. Course Resources

a. **Essential Reading**

1. Research articles
2. Relevant text books
3. Visits to websites relevant to assignment problem

b. **Recommended Reading**

NA

c. **Magazines and Journals**

Relevant Magazines and Journals pertaining to assignment

d. **Websites**

Specific web information pertaining to assignment

e. **Other Electronic Resources**

NA

M.S. Ramaiah University of Applied Sciences * Bangalore - 560054 *

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

SEMESTER - II

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

Course Specifications: Advanced Spectral Analysis (Theory)

Course Title	Advanced Spectral Analysis (Theory)
Course Code	PCC507
Course Type	Core Theory Course
Department	Pharmaceutical Chemistry
Faculty	Pharmacy

1. Course Summary

This course is to impart knowledge in the area of advances in analytical instrumental techniques for identification, characterization and quantification of drugs. Instruments dealt are LC-MS, GC-MS, ATR-IR, DSC etc. The course also deals with the advanced chromatographic techniques, radio immunoassays and Raman spectroscopy.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture:Tutorial:Practical)	4:0:0
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Pharmaceutical Chemistry
Total Course Marks	100 **Component 1: 25 Marks** 1A: Attendance: 8 Marks 1B: Student-Teacher interaction: 2 Marks 1C: Sessional Exam: 15 Marks **Component 2 (SEE):** Semester End Examination: 75 Marks
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO-1. Explain the role of various spectroscopic techniques including UV-Visible and Infra-red spectroscopy in interpretation of organic compounds
CO-2. Summarize the principle and applications of thermal analysis, Raman spectroscopy and immunoassays
CO-3. Apply advanced instrumentation techniques of mass spectroscopy and NMR in interpretation of organic compounds
CO-4. Compare the fundamental principle, instrumentation and applications of different chromatographic methods in pharmaceutical analysis
CO-5. Interpret the various spectra such as IR, Mass and NMR to identify an organic compound
CO-6. Discuss the importance of hyphenated instrumental techniques in pharmaceutical analysis

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

4. Course Contents

Unit 1

UV-Visible spectroscopy:

Wood ward – Fiesure rule for 1,3- butadienes, cyclic dienes and α, β-carbonyl compounds and interpretation compounds of enones.

IR spectroscopy:

ATR-IR, IR Interpretation of organic compounds

12 hours

Unit 2

NMR spectroscopy:

1-D and 2-D NMR, NOESY and COSY, HECTOR, INADEQUATE techniques, interpretation of organic compounds

12 hours

Unit 3

Mass Spectroscopy:

Mass fragmentation and its rules, Fragmentation of important functional groups like alcohols, amines, carbonyl groups and alkanes, Meta stable ions, Mc Lafferty rearrangement, Ring rule, Isotopic peaks, Interpretation of organic compounds.

12 hours

Unit 4

Chromatography:

Principle, Instrumentation and Applications of the following:

a) GC-MS b) GC-AAS c) LC-MS d) LC-FTIR e) LC-NMR f) CE-MS g) High Performance Thin Layer chromatography h) Super critical fluid chromatography i) Ion Chromatography j) I-EC (Ion-Exclusion Chromatography) k) Flash chromatography

12 hours

Unit 5

Thermal methods of analysis:

Introduction, principle, instrumentation and application of DSC, DTA and TGA

Raman Spectroscopy:

Introduction, Principle, Instrumentation and Applications.

Radio immuno assay:

Biological standardization, bioassay, ELISA, Radioimmuno assay of digitalis and insulin

12 hours

(Practical/Laboratory content (please mention if Lab content doesn't exist for this course): Selected experiments pertaining to this course were dealt in the course "Pharmaceutical Chemistry Practical – I PCL505")

M.S. Ramaiah University of Applied Sciences Bangalore - 560 054

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)											Programme Specific Outcomes (PSOs)			
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PSO-1	PSO-2	PSO-3	PSO-4
CO-1	3		1	2				1			1	3	1		
CO-2	3		1	2				1			2	3	2	1	1
CO-3	3		2	3			1	2			2	3	2		
CO-4	3		1	2				2			2	3	2	1	1
CO-5	3		2	3			1	2			2	3	3		
CO-6	3		2	3			1	2			2	3	3	1	1
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution															

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		50
Demonstrations		05
1.Demonstration using Videos	5	
2. Demonstration using Physical Models / Systems		
3. Demonstration on a Computer		
Tutorials		00
Practical Work		
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		05
1. Case Study Presentation	00	
2. Guest Lecture	01	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	01	
5. Group Discussions	02	
6. Discussing Possible Innovations	01	
Written Examination		5
Total Duration in Hours		**65**

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the M.Pharm Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2 or SC3), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation				
	Component 1: CE (25% Weightage)			Component 2: SEE (75% Weightage)
Subcomponent▶	SC1	SC2	SC3	
Subcomponent Type ▶	Attendance	Student – Teacher Interaction	Sessional Exam	Semester End Examination 75 Marks
Maximum Marks▶	8	2	15	
CO-1		X	X	X
CO-2		X	X	X
CO-3		X	X	X
CO-4		X	X	X
CO-5		X	X	X
CO-6		X	X	X
The details of SC1, SC2, SC3 are presented in the Programme Specifications Document.				

Component - 1: 25 marks

The marks allocated for Continuous mode of internal assessment shall be awarded as per the scheme given below:

Criteria	Maximum Marks
Attendance*	8
Student-Teacher Interaction	2
Total	10

1A. Guidelines for the allotment of marks for attendance*

Percentage of Attendance Theory	Marks
95 – 100	8
90 – 94	6
85 – 89	4
80 – 84	2
Less than 80	0

1B. Student-Teacher interaction

1C. Sessional exam: Two sessional exams (each for 30 marks) of 1 hour duration will be conducted, at the end of 6th week and the other at the end of the 12th week. The average of the 2 sessional marks reduced to 15 will be the marks scored in the Sessional Examination

Component - 2: 75 marks

A 3-hour duration Semester End Examination will be conducted for maximum marks of 75. Both components will be evaluated by concerned course leader/s.

Re-assessment

1. A student who fails to secure a minimum 50% in component-1 and 2 put together will be asked to register for Supplementary examination.
2. A student who has not satisfied the attendance requirement (not eligible for SEE) shall have to appear for Supplementary examination.
3. The maximum number of such opportunities are limited and as per the academic regulations governing this Programme.

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Class room lectures, Assignments
2.	Understanding	Class room lectures, Assignments
3.	Critical Skills	Class room lectures, Student-Teacher interaction, Assignments
4.	Analytical Skills	Student-Teacher Interaction
5.	Problem Solving Skills	Class room lectures, Examination and Assignments
6.	Practical Skills	--
7.	Group Work	Assignments
8.	Self-Learning	Assignment
9.	Written Communication Skills	Assignment, Examination, Student-Teacher Interaction
10.	Verbal Communication Skills	Presentations, Student-Teacher Interaction
11.	Presentation Skills	Class room activity, Assignment, Examination
12.	Behavioral Skills	Course work
13.	Information Management	Group discussions and presentations, preparation for examination and presentations
14.	Personal Management	Course work
15.	Leadership Skills	Handling questions during presentations, class room behavior with peers, Student-Teacher interaction

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

9. Course Resources

a. Class Notes

b. Essential Reading

1. Silverstein, RM. Webster, FX (2004) *Spectrometric identification of organic compounds*,6thEdition, New York: John Wiley and Sons.
2. Willard, HH. Merritt, LL. Dean, JA. Settle, FA. *Instrumental methods of analysis*.7thEdition, NewDelhi: CBS Publishers and Distributors.
3. Beckett, AH. Stenlake, JB. (2004*) Practical Pharmaceutical Chemistry*. Vol. I & II. London: The Athlon Press of the University of London.
4. Kemp, W. (2008) *Organic spectroscopy*. 3rdEdition. New York: Palgrave.
5. Skoog, DA. West, DM. Hollen, FG. *Fundamentals of Analytical chemistry*, 6thEdition, USA: Saunders college publishing.
6. Munson, JW. (2001) *Pharmaceutical Analysis-Modern methods-Part B*. Vol II Marcel Dekker series. Mumbai, India: International Medical Book Distributors.
7. Sethi, PD. (2007) *Quantitative Analysis of Drugs in Pharmaceutical formulation* 3rd Edition, New Delhi: CBS Publishers.
8. Sethi, PD. (2012) *Quantitative analysis of pharmaceutical formulations by HPTLC*. 1st edition. CBS Publishers, New Delhi.

c. Recommended Reading

1. Hoffmann ED. Stroobant, V. (2001) *Mass spectrometry: Principles and Applications*. 2ndEd.England: John Wiley and Sons Ltd.
2. Mendham, J. Denny, RC. Barnes, JD. Thomas, M. (2008). *Vogel's Textbook of quantitative chemical analysis*. 6th Edition, New Delhi: Dorling Kindersley (India) Pvt. Ltd., Licensees of Pearson Education in South Asia.
3. United State of Pharmacopeial Convention, (2004). *The United States Pharmacopoeia-27 (NF-22)*. Rockville: MD
4. Government of India, (2014) *Indian Pharmacopoeia*. New Delhi: Government of India
5. Connors, KA. (1982) *A textbook of pharmaceutical analysis*. 3rd Edition, New York: John Wiley and sons.

d. Magazines and Journals

1. Indian Journal of Chemistry Section – B. Niscair Publications, India
2. Asian Journal of chemistry, Asian publication corporation, India
3. Indian Journal of Pharmaceutical Sciences, Indian Pharmaceutical Association, Mumbai

e. Websites

1. www.sciencedirect.com
2. www.pubmed.com

M.S. Ramaiah University of Applied Sciences * Bangalore - 560054 *

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

Course Specifications: Advanced Organic Chemistry-II (Theory)

Course Title	Advanced Organic Chemistry-II (Theory)
Course Code	PCC508
Course Type	Core Theory Course
Department	Pharmaceutical Chemistry
Faculty	Pharmacy

1. Course Summary

The aim of the course is to provide in-depth knowledge of advances in organic chemistry. The emphasis is on different techniques and trends in organic synthesis and their application in drug discovery.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	4:0:0
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Pharmaceutical Chemistry
Total Course Marks	100 **Component 1: 25 Marks** 1A: Attendance: 8 Marks 1B: Student-Teacher interaction: 2 Marks 1C: Sessional Exam: 15 Marks **Component 2 (SEE):** Semester End Examination: 75 Marks
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-1.** Summarize the concepts and strategies of peptide synthesis
- **CO-2.** Analyze various techniques of green chemistry and its applications in organic synthesis
- **CO-3.** Appraise the different types of catalysis and their applications in organic reactions
- **CO-4.** Explain the principles of photochemical and pericyclic reactions
- **CO-5.** Discuss the concepts of stereochemistry and its applications in organic reactions
- **CO-6.** Discuss the trends and advances in organic synthesis and their applications in drug discovery

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

4. Course Contents

Unit 1

Green Chemistry:

a. Introduction, principles of green chemistry
b. Microwave assisted reactions: Merit and demerits of its use, increased reaction rates, mechanism, superheating effects of microwave, effects of solvents in microwave assisted synthesis, microwave technology in process optimization, its applications in various organic reactions and heterocycles synthesis
c. Ultrasound assisted reactions: Types of sonochemical reactions, homogenous, heterogeneous liquid-liquid and liquid-solid reactions, synthetic applications
d. Continuous flow reactors: Working principle, advantages and synthetic applications

12 hours

Unit 2

Chemistry of peptides:

a. Coupling reactions in peptide synthesis
b. Principles of solid phase peptide synthesis, t-BOC and FMOC protocols, various solid supports and linkers: Activation procedures, peptide bond formation, de-protection and cleavage from resin, low and high HF cleavage protocols, formation of free peptides and peptide amides, purification and case studies, site-specific chemical modifications of peptides
c. Segment and sequential strategies for solution phase peptide synthesis with any two case studies
d. Side reactions in peptide synthesis: Deletion peptides, side reactions initiated by proton abstraction, protonation, over-activation and side reactions of individual amino acids.

12 hours

Unit 3

Photochemical Reactions & Pericyclic Reactions:

a. Basic principles of photochemical reactions. Photo-oxidation, photo-addition and photo-fragmentation
b. Mechanism, Types of pericyclic reactions such as cyclo-addition, electro-cyclic reaction and sigmatrophic rearrangement reactions with examples

12 hours

Unit 4

Catalysis:

a. Types of catalysis, heterogeneous and homogenous catalysis, advantages and disadvantages
b. Heterogeneous catalysis – preparation, characterization, kinetics, supported catalysts,
c. catalyst deactivation and regeneration, some examples of heterogeneous catalysis used in synthesis of drugs
d. Homogenous catalysis, hydrogenation, hydroformylation, hydrocyanation, Wilkinson catalysts, chiral ligands and chiral induction, Ziegler-Natta catalysts, some examples of homogenous catalysis used in synthesis of drugs
e. Transition-metal and Organo-catalysis in organic synthesis: Metal-catalysed reactions
f. Biocatalysis: Use of enzymes in organic synthesis, immobilized enzymes/cells in organic reaction.
g. Phase transfer catalysis - theory and applications

12 hours

Dean - Academics
M.S. Ramaiah University of Applied Sciences

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

Unit 5

Stereochemistry & Asymmetric Synthesis:

a. Basic concepts in stereochemistry – optical activity, specific rotation, racemates and resolution of racemates, the Cahn, Ingold, Prelog (CIP) sequence rule, meso compounds, pseudo asymmetric centres, axes of symmetry, Fischers D and L notation, cis-trans isomerism, E and Z notation.

b. Methods of asymmetric synthesis using chiral pool, chiral auxiliaries and catalytic asymmetric synthesis, enantiopure separation and Stereo selective synthesis with examples.

12 hours

(Practical/Laboratory content (please mention if Lab content doesn't exist for this course): Selected experiments pertaining to this course were dealt in the course "Pharmaceutical Chemistry Practical - II PCL511")

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)											Programme Specific Outcomes (PSOs)			
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PSO-1	PSO-2	PSO-3	PSO-4
CO-1	3	2	2	2			1	1	1		1	3	1		1
CO-2	3	2		2			1	1		2	1	3	1		1
CO-3	3		1	1			1	1		2	1	3	1		1
CO-4	3			2				1			1	3			1
CO-5	3		1	3				1			1	3	2		2
CO-6	3	1	1	3				1			1	3	2		2
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution															

M.S. Ramaiah University of Applied Sciences * Bangalore - 560054 *

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		50
Demonstrations		05
1. Demonstration using Videos	5	
2. Demonstration using Physical Models / Systems		
3. Demonstration on a Computer		
Tutorials		00
Practical Work		
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		05
1. Case Study Presentation	00	
2. Guest Lecture	01	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	01	
5. Group Discussions	02	
6. Discussing Possible Innovations	01	
Written Examination		5
Total Duration in Hours		**65**

M.S. Ramaiah University of Applied Sciences

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the M. Pharm Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2 or SC3), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation				
	Component 1: CE (25% Weightage)			Component 2: SEE (75% Weightage)
Subcomponent ▶	SC1	SC2	SC3	
Subcomponent Type ▶	Attendance	Student – Teacher Interaction	Sessional Exam	Semester End Examination 75 Marks
Maximum Marks ▶	8	2	15	
CO-1		x	x	x
CO-2		x	x	x
CO-3		x	x	x
CO-4		x	x	x
CO-5		x	x	x
CO-6		x	x	x
The details of SC1, SC2, SC3 are presented in the Programme Specifications Document.				

Component - 1: 25 marks

The marks allocated for Continuous mode of internal assessment shall be awarded as per the scheme given below:

Criteria	Maximum Marks
Attendance*	8
Student-Teacher Interaction	2
Total	10

1A. Guidelines for the allotment of marks for attendance*

Percentage of Attendance Theory	Marks
95 – 100	8
90 – 94	6
85 – 89	4
80 – 84	2
Less than 80	0

1B. Student-Teacher interaction

1C. Sessional exam: Two sessional exams (each for 30 marks) of 1 hour duration will be conducted, one at the end of 6th week and the other at the end of the 12th week. The average of the 2 sessional marks reduced to 15 will be the marks scored in the Sessional Examination

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Component - 2: 75 marks
A 3 hour duration Semester End Examination will be conducted for maximum marks of 75. Both components will be evaluated by concerned course leader/s.

Re-assessment
1. A student who fails to secure a minimum 50% in component-1 and 2 put together will be asked to register for Supplementary examination.
2. A student who has not satisfied the attendance requirement (not eligible for SEE) shall have to appear for Supplementary examination.
3. The maximum number of such opportunities is limited and as per the academic regulations governing this Programme.

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Class room lectures, Assignments
2.	Understanding	Class room lectures, Assignments
3.	Critical Skills	Class room lectures, Student-Teacher interaction, Assignments
4.	Analytical Skills	Student-Teacher Interaction
5.	Problem Solving Skills	Class room lectures, Examination and Assignments
6.	Practical Skills	--
7.	Group Work	Assignments
8.	Self-Learning	Assignment
9.	Written Communication Skills	Assignment, Examination, Student-Teacher Interaction
10.	Verbal Communication Skills	Presentations, Student-Teacher Interaction
11.	Presentation Skills	Class room activity, Assignment, Examination
12.	Behavioral Skills	Course work
13.	Information Management	Group discussions and presentations, preparation for examination and presentations
14.	Personal Management	Course work
15.	Leadership Skills	Handling questions during presentations, class room behavior with peers, Student-Teacher interaction

Registrar
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

9. **Course Resources**

a. **Class Notes**

b. **Essential Reading**

1. March, J. (2007) Advanced Organic Chemistry- Reactions, Mechanism and Structure, 6th Edition, New York: John-Wiley & Sons.
2. Nelson, W. M. (2003) Green Solvents for Chemistry; Perspective and Practice, USA: Oxford University Press.
3. Smith, M. B. (2002) Organic Synthesis, 2nd Edition, New York: Mc Graw Hill.
4. Morison, R.T. & Boyd R. N. (2002) Organic Chemistry, 6th Edition, New Delhi: Prentice Hall of India Pvt. Ltd.
5. Finar, I. L. (1995) Organic Chemistry - Fundamental Principles Vol I & II, 6th Edition, London: ELBS, Longman.
6. Clayden, J. Greeves, N. Warren, S. (2012) Organic Chemistry, 2nd Edition, UK: Oxford University Press.
7. Gould, E.S. (1963) Mechanism and Structure in Organic Chemistry, New York: Holt, Rinehart and Winston.
8. Norman, R.O.C. Coxon, J.M. (1993) Principles of Organic Synthesis, 3rd Edition, UK: Oxford University Press.
9. Ahluwalia, V.K. Aggarwal, R. (2012) Organic Synthesis - Special Techniques, 2nd Edition, New Delhi: Narosa Publishing House.
10. Ahluwalia, V.K. Parashar, R.K. (2010) Organic Reaction Mechanisms, 4th Edition, New Delhi: Narosa Publishing House.

c. **Recommended Reading**

1. Sykes, P. (1981) A Guide Book to Mechanism in Organic Chemistry, 5th Edition, New Delhi: Orient Longman Limited.
2. Cary, A. and Sundberg, R. I. (2009) Advanced Organic Chemistry, Part A and B, 5th Edition, New York: Springer.
3. Clarke, J. &Macquarrie, D. (2002) Handbook of green chemistry and technology, London: Blackwell Science ltd.
4. Kappe, C.O. Stadler, A. (2005) Microwaves in organic and medicinal Chemistry, Weiheim: Wiley- VCH.
5. Lednicer, D. Mitscher, L. A. (1977) Organic Chemistry of Synthetic Drugs, New York: Wiley, Interscience Publications.
6. Warren, S. Wyatt, P. (2008) Organic Synthesis: the disconnection approach, 2nd Edition, New York: Weley, Blackwell.

d. **Magazines and Journals**

1. Indian Journal of Chemistry Section – B, New Delhi: CSIR – NISCAIR Publications.
2. Indian Journal of Heterocyclic Chemistry, Lucknow: National Academy of Chemistry and Biology.
3. Indian Journal of Pharmaceutical Sciences, OMICS International on behalf of the Indian Pharmaceutical Association (India).

e. **Websites**

1. www.sciencedirect.com
2. www.elsevier.com

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Course Specifications: Computer Aided Drug Design (Theory)

Course Title	Computer Aided Drug Design (Theory)
Course Code	PCC509
Course Type	Core Theory Course
Department	Pharmaceutical Chemistry
Faculty	Pharmacy

1. Course Summary

The aim of this course is to provide detailed knowledge of computer aided drug design for new drug discovery and development. The course deals with the concepts of QSAR and molecular modeling. The emphasis is also on virtual screening methodology

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	4:0:0
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Pharmaceutical Chemistry
Total Course Marks	100 **Component 1: 25 Marks** 1A: Attendance: 8 Marks 1B: Student-Teacher interaction: 2 Marks 1C: Sessional Exam: 15 Marks **Component 2 (SEE):** Semester End Examination: 75 Marks
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-1.** Summarize the different Computer Aided Drug Design (CADD) techniques and their applications
- **CO-2.** Outline the objectives of QSAR, molecular modeling and virtual screening methods
- **CO-3.** Discuss the methodology for QSAR studies and concepts of molecular modeling
- **CO-4.** Determine physico-chemical parameter values for drug molecules
- **CO-5.** Analyze the *in silico* virtual screening protocols
- **CO-6.** Develop strategies for design and development of new drug molecules

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

4. Course Contents

Unit 1

History, different techniques and applications. Quantitative Structure Activity Relationships-Basics

History and development of QSAR; Physicochemical parameters and methods to calculate physicochemical parameters: Hammett equation and electronic parameters (sigma), lipophilicity effects and parameters (log P, pi-substituent constant), steric effects (Taft steric and MR parameters) Experimental and theoretical approaches for the determination of these physicochemical parameters.

12 hours

Unit 2

Quantitative Structure Activity Relationships: Applications

Hansch analysis, Free Wilson analysis and relationship between them, Advantages and disadvantages; Deriving 2D-QSAR equations. 3D-QSAR approaches and contour map analysis. Statistical methods used in QSAR analysis and importance of statistical parameters.

12 hours

Unit 3

Molecular Modeling and Docking

a) Molecular and Quantum Mechanics in drug design.

b) Energy Minimization Methods: comparison between global minimum conformation and bioactive conformation

c) Molecular docking and drug receptor interactions: Rigid docking, flexible docking and extra-precision docking. Agents acting on enzymes such as DHFR, HMG-CoA reductase and HIV protease, choline esterase (AchE & BchE)

12 hours

Unit 4

Molecular Properties and Drug Design

a) Prediction and analysis of ADMET properties of new molecules and its importance in drug design.

b) De novo drug design: Receptor/enzyme-interaction and its analysis, Receptor/enzyme cavity size prediction, predicting the functional components of cavities, Fragment based drug design.

c) Homology modeling and generation of 3D-structure of protein.

12 hours

Unit 5

Pharmacophore Mapping and Virtual Screening

Concept of pharmacophore, pharmacophore mapping, identification of Pharmacophore features and Pharmacophore modeling; Conformational search used in pharmacophore mapping.

In Silico Drug Design and Virtual Screening Techniques Similarity based methods and Pharmacophore based screening, structure based In-silico virtual screening protocols.

12 hours

(Practical/Laboratory content (please mention if Lab content doesn't exist for this course) : Selected experiments pertaining to this course were dealt in the course "Pharmaceutical Chemistry Practical - I PCL505")

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)											Programme Specific Outcomes (PSOs)			
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PSO-1	PSO-2	PSO-3	PSO-4
CO-1	3		2	3				2			2	3	3		2
CO-2	3			2				2			2	3	2		2
CO-3	3		2	3				2			2	3	3		2
CO-4	3		2	3			1	2		2	3	3	2		1
CO-5	3		3	3			2	2		2	2	3	3	2	3
CO-6	3		3	3			2	2		2	2	3	3	2	3
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution															

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		40
Demonstrations		10
1. Demonstration using Videos	5	
2. Demonstration using Physical Models / Systems		
3. Demonstration on a Computer	5	
Tutorials		50
Practical Work		
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		05
1. Case Study Presentation	00	
2. Guest Lecture	01	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	01	
5. Group Discussions	02	
6. Discussing Possible Innovations	01	
Written Examination		5
Total Duration in Hours		**65**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the M. Pharm Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2 or SC3), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation				
	Component 1: CE (25% Weightage)			Component 2: SEE (75% Weightage)
Subcomponent ▶	SC1	SC2	SC3	
Subcomponent Type ▶	Attendance	Student – Teacher Interaction	Sessional Exam	Semester End Examination 75 Marks
Maximum Marks ▶	8	2	15	
CO-1		×	×	×
CO-2		×	×	×
CO-3		×	×	×
CO-4		×	×	×
CO-5		×	×	×
CO-6				×
The details of SC1, SC2, SC3 are presented in the Programme Specifications Document.				

Component - 1: 25 marks

The marks allocated for Continuous mode of internal assessment shall be awarded as per the scheme given below:

Criteria	Maximum Marks
Attendance*	8
Student-Teacher Interaction	2
Total	10

1A. Guidelines for the allotment of marks for attendance*

Percentage of Attendance Theory	Marks
95 – 100	8
90 – 94	6
85 – 89	4
80 – 84	2
Less than 80	0

1B. Student-Teacher interaction

1C. Sessional exam: Two sessional exams (each for 30 marks) of 1 hour duration will be conducted, one at the end of 6th week and the other at the end of the 12th week. The average of the 2 sessional marks reduced to 15 will be the marks scored in the Sessional Examination

Component - 2: 75 marks

A 3 hour duration Semester End Examination will be conducted for maximum marks of 75. Both components will be evaluated by concerned course leader/s.

Re-assessment

1. A student who fails to secure a minimum 50% in component-1 and 2 put together will be asked to register for Supplementary examination.

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

2. A student who has not satisfied the attendance requirement (not eligible for SEE) shall have to appear for Supplementary examination.
3. The maximum number of such opportunities are limited and as per the academic regulations governing this Programme.

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Class room lectures, Assignments
2.	Understanding	Class room lectures, Assignments
3.	Critical Skills	Class room lectures, Student-Teacher interaction, Assignments
4.	Analytical Skills	Student-Teacher Interaction
5.	Problem Solving Skills	Class room lectures, Examination and Assignments
6.	Practical Skills	--
7.	Group Work	Assignments
8.	Self-Learning	Assignment
9.	Written Communication Skills	Assignment, Examination, Student-Teacher Interaction
10.	Verbal Communication Skills	Presentations, Student-Teacher Interaction
11.	Presentation Skills	Class room activity, Assignment, Examination
12.	Behavioral Skills	Course work
13.	Information Management	Group discussions and presentations, preparation for examination and presentations
14.	Personal Management	Course work
15.	Leadership Skills	Handling questions during presentations, class room behavior with peers, Student-Teacher interaction

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

9. Course Resources

a. Class Notes

b. Essential Reading

1. Abraham, DJ. (2003) Burgers Medicinal chemistry and Drug discovery part-I & II.6th ed. USA: John Wiley & Sons Inc.
2. Hansch, C. (2005) Comprehensive Medicinal Chemistry Vol. 1 -6. England: Pergamon press –an imprint of Elsevier.
3. Smith, H J . Williams, D R. (2006) Introduction to the principles of Drug design and action. 4th ed. USA: CRC Press Taylor &Francis group.
4. Thomas, G. (2008) Medicinal Chemistry: An Introduction .2nd ed. UK: John Wiley & sons Ltd.
5. Thomas, L L. David, AW. (2013) Foye's Principles of Medicinal Chemistry.7th ed. USA: Lippincott Williams & Wilkins.
6. Patrick, G L. (2007) An Introduction to Medicinal chemistry.4th ed. UK: Oxford University press.

c. Recommended Reading

1. Silverman, R B. (2004) The organic chemistry of Drug design and action 2nd ed. USA: Elsevier.
2. Ellis, GP and West, GB. (1969) Progress in Medicinal Chemistry Series. Amsterdam: Elsevier
3. Ariens, EJ.Ed. (1980) Medicinal Chemistry Series. UK: Academic press

d. Magazines and Journals

1. Journal of computational Chemistry – Wiley online library USA
2. Journal of theoretical and computational Chemistry – World Scientific California
3. Journal of molecular modeling – Springer, UK

e. Websites

1. www.sciencedirect.com
2. www.elsevier.com

M.S. Ramaiah University of Applied Sciences * Bangalore - 560054 *

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Course Specifications: Pharmaceutical Process Chemistry

Course Title	Pharmaceutical Process Chemistry (Theory)
Course Code	PCC510
Course Type	Core Theory Course
Department	Pharmaceutical Chemistry
Faculty	Pharmacy

1. **Course Summary**

The aim of this course is to impart knowledge in the development and optimization of a synthetic route/s and the pilot plant procedure for the manufacture of Active Pharmaceutical Ingredients (APIs) and New Chemical Entities (NCEs) for the drug development phase. The course emphasizes on development of pharmaceutical processes that are safe, cost effective and environmentally friendly.

2. **Course Size and credits**:

Number of credits	04
Credit Structure (Lecture:Tutorial:Practical)	4:0:0
Total hours of interaction	60
Number of Weeks in a Semester	15
Department Responsible	Pharmaceutical Chemistry
Total Course Marks	100 Component I: 25Marks 1A: Attendance: 8 marks 1B: Student: Teacher Interaction: 2 marks 1C: Sessional Exam – 15 Marks Component 2(SEE): Semester End Examination: 75 Marks
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

M.S. Ramaiah University of Applied Sciences Bangalore - 560054

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

3. **Course Outcomes (COs)**

After the successful completion of this course, the student will be able to:

CO-1. Discuss the methods for synthesis of APIs and scale up of processes for large scale production

CO-2. Compose different types of unit operations applied in the manufacturing and purification of APIs

CO-3. Develop the chemical processes for pharmaceutical manufacturing

CO-4. Apply procedures like reduction, fermentation for the production of important drugs and antibiotics

CO-5. Recommend safety measures for the management of industrial hazards in the pharmaceutical industry

CO-6. Design strategies for manufacturing of APIs on large scale in industry in a safe and cost-effective manner

4. **Course Contents**

Unit 1

Process chemistry: Introduction, Synthetic strategy, Stages of scale up process: Bench, pilot and large-scale process. In-process control and validation of large-scale process. Case studies of some scale up process of APIs. Impurities in API, types and their sources including genotoxic impurities. **12 Hours**

Unit 2

Unit operations: *Extraction:* Liquid equilibria, extraction with reflux, extraction with agitation, counter current extraction. *Filtration*: Theory of filtration, pressure and vacuum filtration, centrifugal filtration. *Distillation*: azeotropic and steam distillation. *Evaporation*: Types of evaporators, factors affecting evaporation. *Crystallization*: Crystallization from aqueous, non-aqueous solutions factors affecting crystallization, nucleation. Principle and general methods of preparation of polymorphs, hydrates, solvates and amorphous APIs. **12 Hours**

Unit 3

Unit Processes: Nitration: Nitrating agents, Aromatic nitration, kinetics and mechanism of aromatic nitration, process equipment for technical nitration, mixed acid for nitration. **Halogenation:** Kinetics of halogenations, types of halogenations, catalytic halogenations. Case study on industrial halogenation process.

Oxidation: Introduction, types of oxidative reactions, Liquid phase oxidation with oxidizing agents. Non-metallic Oxidizing agents such as H_2O_2, sodium hypochlorite, Oxygen gas, ozonolysis. **12 Hours**

Unit 4

Unit Processes: Reduction: Catalytic hydrogenation, Heterogeneous and homogeneous catalyst; Hydrogen transfer reactions, Metal hydrides. Case study on industrial reduction process.

Fermentation: Aerobic and anaerobic fermentation. Production of i. Antibiotics; Penicillin and Streptomycin, ii. Vitamins: B2 and B12 **iii.** Statins: lovastatin, simvastatin

Reaction progress kinetic analysis: Streamlining reaction steps, route selection, Characteristics of expedient routes, characteristics of cost-effective routes, reagent selection, families of reagents useful for scale-up **12 Hours**

Unit 5

Industrial Safety: MSDS (Material Safety Data Sheet), hazard labels of chemicals and Personal

Protection Equipment (PPE). Fire hazards, types of fire & fire extinguishers. Occupational Health &Safety Assessment Series 1800 (OHSAS-1800) and ISO-14001(Environmental Management System), Effluents and its management. **12 Hours**

(Practical content (please mention if Lab content doesn't exist for this course): Selected Experiments pertaining to this course were dealt in the course "Pharmaceutical Chemistry Practical – I PCL505")

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)											Programme Specific Outcomes (PSOs)			
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PSO-1	PSO-2	PSO-3	PSO-4
CO-1	3	2	2	2	1	-	-	1	-	2	1	3	1	1	-
CO-2	3	2	2	2	1	-	-	1	-	2	1	3	2	1	1
CO-3	3	2	3	3	1	-	-	1	-	2	1	3	2	1	1
CO-4	3	2	3	2	1	-	-	1	-	2	1	3	3	1	2
CO-5	3	2	2	3	1	-	-	1	-	2	1	3	3	1	2
CO-6	3	2	3	3	1	-	-	1	-	2	1	3	3	1	2
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution															

Teaching and Learning Methods		Duration inHours
Face to Face Lectures		50.00
Demonstrations		5.00
1. Demonstration using Videos	5	
2. Demonstration using Physical Models/Systems	00	
3. Demonstration on a Computer	00	
Numeracy		
1. Solving Numerical Problems	00	
Practical Work		
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop/Course Workshop/Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
Others		5.00
1. Case Study Presentation	2	
2. Guest Lecture	00	
3. Industry/Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	3	
6. Discussing Possible Innovations	00	
Written Examination		5.00
Total Duration in Hours		65.00

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

6.Course Teaching and Learning Methods

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the M. Pharm Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2 or SC3), COs are assessed as illustrated in the following Table

Focus of COs on each Component or Subcomponent of Evaluation				
	Component 1: CE (25% Weightage)			Component 2: SEE (75% Weightage)
Sub component	SC1	SC2	SC3	
Sub component Type	Attendance	Student – Teacher Interaction	Sessional Exam	Semester End Examination 75 Marks
Maximum Marks	8	2	15	
CO-1		X	X	X
CO-2		X	X	X
CO-3		X	X	X
CO-4		X	X	X
CO-5		X	X	X
CO-6		X	X	X
The details of SC1, SC2, SC3 are presented in the Programme Specifications Document.				

Component –I: 25 Marks

The marks allocated for Continuous mode of internal assessment shall be awarded as per the scheme given below:

Criteria	Maximum marks
Attendance *	8
Student –Teacher Interaction	2
Total	10

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

1A. Guidelines for allotment of marks for attendance*

Percentage of Attendance Theory	Maximum marks
95-100	8
90-94	6
85-89	4
80-84	2
Less than 80	0

1B: Student-Teacher interaction

1C. Sessional exam: Two sessional exams (each for 30 marks) of 1-hour duration will be conducted, one at the end of 6th week and the other at the end of the 12th week. The average of the 2 sessional marks reduced to 15 will be the marks scored in the Sessional Examination

Component -2:75 Marks

A 3-hour duration Semester End Examination will be conducted for maximum marks of 75. Both components will be evaluated by a concerned course leader/s

Reassessment

1. A student who fails to secure a minimum 50% in component-1 and 2 put together will be asked to register for Supplementary examination.
2. A student who has not satisfied the attendance requirement (not eligible for SEE) shall have to appear for Supplementary examination.
3. The maximum number of such opportunities are limited and as per the academic regulations governing this Programme.

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document

M.S. Ramaiah University of Applied Sciences * Bangalore - 560054 *

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Class room lectures, Assignments
2.	Understanding	Class room lectures, Assignments
3.	Critical Skills	Class room lectures, Student-Teacher interaction, Assignments
4.	Analytical Skills	Student-Teacher Interaction
5.	Problem Solving Skills	Class room lectures, Examination and Assignments
6.	Practical Skills	--
7.	Group Work	Assignments
8.	Self-Learning	Assignment
9.	Written Communication Skills	Assignment, Examination, Student-Teacher Interaction
10.	Verbal Communication Skills	Presentations, Student-Teacher Interaction
11.	Presentation Skills	Class room activity, Assignment, Examination
12.	Behavioral Skills	Course work
13.	Information Management	Group discussions and presentations, preparation for examination and presentations
14.	Personal Management	Course work
15.	Leadership Skills	Handling questions during presentations, class room behavior with peers, Student-Teacher interaction

M.S. Ramaiah University of Applied Sciences Bangalore - 560054

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

9. Course Resources

a. Class Notes

b. Essential reading

1. Course notes
2. Gadamasetti, K. (2008) *Process Chemistry in the Pharmaceutical Industry: Challenges in an Ever-Changing Climate-An Overview*1st edn. New Delhi: CRC Press, Taylor and Francis Group.
3. Pharmaceutical Manufacturing Encyclopedia (2007), 3rd edn, Volume 2. New York: William Andrew Publishing.
4. Abraham, D. J. and Rotella, D. P. (2010) *Burger's Medicinal Chemistry, Drug Discovery and Development* 6th edn, Volume 1-8. London: Wiley.
5. Brittain, H. G. (1999) *Polymorphism in Pharmaceutical Solids. Dekker Series* 95th edn, New York: Marcel Dekker.
6. Murphy, R. M. (2005) *Introduction to Chemical Processes: Principles, Analysis, Synthesis*1st edn. New York: McGraw Hill.
7. Peter, J. (2010) *Harrington: Pharmaceutical Process Chemistry for Synthesis: Rethinking the Routes to Scale-Up* 1st edn.London: Wiley.
8. Groggins, P. H. (2004) *Unit processes in organic synthesis* 5th edn. New Delhi: Tata McGraw Hill Education.
9. International Conference on Harmonisation (ICH) Quality Guidelines: Pharmaceutical, Biologics, and Medical Device Guidance Documents Concise Reference. (2010). North Carolina: Pharma Logika.

c. Recommended Reading

1. Gopal Rao, M and Sittig, M. (1997) *Dryden's Outlines of Chemical Technology* 3rd edn. New Delhi: East West Press.
2. Clausen and Mattson. (1978) *Principle of Industrial Chemistry*, London: Wiley.
3. Shukla, S. Dand Pandey, G. N. (1986) *A text book of Chemical Technology* Vol. II 2nd edn. New Delhi: Vikas Publishing House Pvt Ltd.
4. Stille, J. K.(1968) *Industrial Organic Chemistry* 1st edn. New Jersey: Prentice Hall.
5. Sharma, B. K. (1985) *Industrial Chemistry*. Meerut: Goel Publishing House.

d. Magazines and Journals

1. Journal of Pharmaceutical Innovation.USA: Springer.
2. Journal of Pharmaceutical Sciences. Amsterdam: Elsevier.
3. Separation Science and Technology. New York: Marcell Dekker Inc.
4. Reaction Chemistry and Engineering. UK: Royal Society of Chemistry.

e. Websites

1. website www.fda.gov
2. www.sciencedirect.com
3. www.pubmed.comhttp://www.pubmed.com/

M.S. Ramaiah University of Applied Sciences * Bangalore - 560 054 *

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

Course Specifications: Pharmaceutical Chemistry Practical -II (practical)

Course Title	Pharmaceutical Chemistry Practical -II (Practical)
Course Code	PCL511
Course Type	Core practical Course
Department	Pharmaceutical Chemistry
Faculty	Pharmacy

1. Course Summary

The aim of this course is to train students with necessary skills involved in synthetic pathways and strategies of rational drug design. Students are also exposed to computer assisted drug design

2. Course Size and Credits:

Number of Credits	06
Credit Structure (Lecture:Tutorial:Practical)	0:0:12
Total Hours of Interaction	180
Number of Weeks in a Semester	15
Department Responsible	Pharmaceutical Chemistry
Total Course Marks	Total Marks: 150 **Component 1: 50 Marks** **A: Continuous Evaluation:20 Marks** 1A: Attendance: 10 Marks 2A: Practical Record and Viva Voce-10 Marks **B. Sessional Examination: 30 Marks** **Component 2 (SEE): 100 Marks** Semester End Examination: 100 Marks
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-1.** Synthesize drug molecules or intermediates by applying different synthetic routes
- **CO-2.** Deduce the structure of organic compounds by interpretation of UV, IR, NMR and Mass Spectral data
- **CO-3.** Design new drug like molecules by molecular modeling and docking studies
- **CO-4.** Predict the ADMET properties of new compounds and generate QSAR equations

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

4. Course Contents D

1. Synthesis of organic compounds by adapting different approaches involving (3 experiments)
   a) Oxidation
   b) Reduction/hydrogenation
   c) Nitration
2. Comparative study of synthesis of APIs/intermediates by different synthetic routes (2 experiments)
3. Assignments on regulatory requirements in API (2 experiments)
4. Comparison of absorption spectra by UV and Wood ward – Fieser rule
5. Interpretation of organic compounds by FT-IR
6. Interpretation of organic compounds by NMR
7. Interpretation of organic compounds by MS
8. Determination of purity by DSC in pharmaceuticals
9. Identification of organic compounds using FT-IR, NMR, CNMR and Mass spectra

To carry out the preparation of following organic compounds

1. Preparation of 4-chlorobenzhydrylpiperazine. (An intermediate for cetirizine HCl)
2. Preparation of 4-iodotolene from p-toluidine.
3. $NaBH_4$ reduction of vanillin to vanillyl alcohol
4. Preparation of umbelliferone by Pechhman reaction
5. Preparation of triphenyl imidazole
6. To perform the Microwave irradiated reactions of synthetic importance (Any two)
7. Determination of log P, MR, hydrogen bond donors and acceptors of selected drugs using software's
8. Calculation of ADMET properties of drug molecules and its analysis using software's
9. Pharmacophore modeling
10. 2D-QSAR based experiments
11. 3D-QSAR based experiments
12. Docking study-based experiment
13. Virtual screening-based experiment

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)											Programme Specific Outcomes (PSOs)			
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PSO-1	PSO-2	PSO-3	PSO-4
CO-1	3	2	1	1	1		1		1	1	1	3	1	1	
CO-2	3	2	2	1	1		1		1		1	3	2	1	
CO-3	3	2	2	2	2		1		1		1	3	2	1	1
CO-4	3	2	1	2	2		1		1		1	3	3	1	1
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution															

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		10
Demonstrations		15
1.Demonstration using Videos	10	
2. Demonstration using Physical Models / Systems		
3. Demonstration on a Computer	5	
Tutorials		00
Practical Work		145
1. Course Laboratory	145	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		10
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	05	
5. Group Discussions	00	
6. Discussing Possible Innovations	05	
Written Examination		20
Total Duration in Hours		**200**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the M.Pharm Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2 or SC3), COs are assessed as illustrated in the following Table.

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Focus of COs on each Component or Subcomponent of Evaluation				
	Component 1: CE (25% Weightage)			Component 2: SEE (75% Weightage)
Subcomponent▶	SC1	SC2	SC3	
Subcomponent Type ▶	Attendance	Practical Records, Regular Viva voce	Sessional Exam	Semester End Examination 100 Marks
Maximum Marks▶	10	10	30	
CO-1		×	×	×
CO-2		×	×	×
CO-3		×	×	×
CO-4		×	×	×
The details of SC1, SC2, SC3 are presented in the Programme Specifications Document.				

Component - 1: 20 marks

The marks allocated for Continuous mode of internal assessment shall be awarded as per the scheme given below:

Criteria	Maximum Marks
Attendance*	10
Practical Records, Regular viva voce	10
Total	20

1A. Guidelines for the allotment of marks for attendance*

Percentage of Attendance Theory	Marks
95 – 100	10
90 – 94	7.5
85 – 89	5
80 – 84	2.5
Less than 80	0

Registrar
M.S. Ramaiah University
Bangalore - 560 ...

1B. Sessional Examination: 30 Marks

Two sessional exams (each for 30 marks) of6 hour duration will be conducted, at the end of 6th week and the other at the end of the 12th week. The average of the 2 sessional marks reduced to 15 will be the marks scored in the Sessional Examination

Component - 2: Semester End Practical Examination 100 marks

A 6-hour duration Semester End Examination will be conducted for maximum marks of 100.

Component -2 will be evaluated by the course leader and the external examiner.

Re-assessment

1. A student who fails to secure a minimum 50% in component-1 and 2 put together will be asked to register for Supplementary examination.
2. A student who has not satisfied the attendance requirement (not eligible for SEE) shall have to appear for Supplementary examination.
3. The maximum number of such opportunities are limited and as per the academic regulations governing this Programme.

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

Dean - Academics
M.S. Ramaiah University of Applied Sciences
... - 560 054

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S.No.	Curriculum and Capabilities Skills	How imparted during the course
1	Knowledge	Laboratory interactions and self-study
2	Understanding	Experiments conducted in laboratory
3	Critical Skills	Experiments conducted in laboratory
4	Analytical Skills	Inference of laboratory results
5	Problem Solving Skills	Lab work and Examination
6	Practical Skills	Face to face interactions and lab work
7	Group Work	Laboratory Tasks
8	Self-Learning	Practical Record writing and Examination
9	Written Communication Skills	Viva voce and presentation of results
10	Verbal Communication Skills	Presentation of results
11	Presentation Skills	Laboratory Tasks
12	Behavioral Skills	Practical Record writing and presentation of results
13	Information Management	Group discussions and planning of Laboratory Tasks
15	Leadership Skills	Presentation, Handling Questions during presentation, Interaction with peers

M.S. Ramaiah University of Applied Sciences

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

9. Course Resources

a. Class Notes

b. Essential Reading

1. Lab manual
2. Martin, Y.C.(2010) *Quantitative Drug Design*,2nd edition ,Florida:CRC Press.
3. Ariens,E.J.(1980) *Drug Design*,1-10 Volumes,United States:Academic Press Inc.
4. Smith, J.H.(2005) *Introduction to the principles of Drug Design and Action* ,4th edition ,United States:CRCPress.
5. Silverman, R.B.,Holladay W.M.(2014) *The organic Chemistry of drug Design and Drug Action*,3rd editionUnited States:Academic Press.
6. Abraham, J.D, *Burger's medicinal Chemistry Drug Discovery*, New Jersey: John Wiley &Sons Inc.
7. Clayden ,J. Greeves,N. Warrens,S.(2012) *Organic Chemistry*,2nd edition, UK: Oxford University Press..
8. Silverstein,R.M. Webster,FX (2004) *Spectrometric Identification of organic compounds* , 6thEd. New York:John Wiley and Sons.
9. Kemp, W. (2008) *Organic spectroscopy*, 3rdedition. New York: Palgrave.
10. Gadamasetti,K. Braish,T.(2008) *Process Chemistry in the Pharmaceutical Industry Challenges in an EverChanging Climate* ,Volume 2,Florida: CRC Press.
11. Warren,L .McCabe,Smith,J.C. Harriot,P.(1993)*Unit Operations of Chemical Engineering* 5th edition,NewDelhi: McGraw-Hill, Inc.

c. Recommended Reading

1. Ahluwalia, V. K. Aggarwal, *R.*(2012) *Organic Synthesis –Special Techniques*,2nd edition, New Delhi : Narosa publishing House.
2. Skoog, .DA. West, D.M. Hollen, FG. (2014). *Fundamentals of Analytical chemistry*, 9th edition. USA:Saunders college publishing.
3. Connors, K.A. (1982). A textbook of pharmaceutical analysis. 3rd edition .New York: John Wiley and sons.
4. ICH Guidelines.
5. Sharma, B.K.(1997) Industial Chemistry, Meerut: Goel Publishing House.

d. Magazines and Journals

1. European Journal of Organic Chemistry, ChemPub Soc Europe
2. European Journal of Medicinal Chemistry, French Société de Chimie Thérapeutique
3. International Journal of Chemistry and Application, Algeria: International Research Publication House,
4. Journal of Pharmaceutical Analysis, Xi'an: Xi'an Jiaotong University.
5. Indian Journal of Pharmaceutical Sciences, Indian Pharmaceutical Association, Mumbai
6. Journal of Pharmaceutical and Biomedical Analysis, ScienceDirect,Amsterdam

e. Websites

1. www.sciencedirect.com
2. www.pubmed.com
3. www.fda.gov

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Course Specifications: Seminar/Assignment

Course Title	Seminar/Assignment
Course Code	PCS512
Department	Pharmaceutical Chemistry
Faculty	Pharmacy

1. Course Summary

The course aims to instill critical thinking, analytical thinking and problem-solving skills amongst students. Students are trained to refer to literature and present their thought process, justification either in the form of an essay or debate as a concise report. Students are trained for collaborative learning while analyzing and also solving problems. They are exposed to citation, referencing and paraphrasing. Students are also exposed in communicating the collected information/literature to present and defend their accomplishment.

2. Course Size and Credits:

Number of credits	04
Total hours of class room and laboratory interaction during the course	105 hours in a semester
Total Course Marks	**100** **Component -1: Assignment = 60 Marks** Report evaluated individually for 15 marks for 4 theory Courses in the semester. **Component-2: Seminar = 40 Marks** Assignment presentation evaluated individually for 10 marks for 4 theory Courses in the semester.
Pass Criteria	As per the Academic Regulations
Attendance requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-1.** Develop critical thinking, analytical thinking and problem-solving skills
- **CO-2.** Demonstrate the ability to synthesise the report
- **CO-3.** Develop academic report with appropriate citation and referencing style
- **CO-4.** Communicate the contents of the report to the panel
- **CO-5.** Defend the contents of the report in the panel

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

4. Course Contents

Critical review of the literature on the given assignment
Writing and Communication skills
Citation and referencing styles- Harvard referencing style
Plagiarism review
Analytical and problem-solving skills
Practical/Laboratory content: NA

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)											Programme Specific Outcomes (PSOs)			
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PSO-1	PSO-2	PSO-3	PSO-4
CO-1	1	3	3	1	1	2		1		2	2	1	1	2	2
CO-2	2	3	2	2		1		3		2	1	1	1	2	3
CO-3	3	1	1	3	1	2		3	1		3	1	1		2
CO-4	1	2	2	3	2	2	2	3	1		3	1	1	2	2
CO-5	3		2	3		1	2	3		1	3	1	1	2	2
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution															

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration inHours
Face to Face Lectures		10
Demonstrations		10
1. Demonstration using Videos		
2. Demonstration using Physical Models/Systems	5	
3. Demonstration on a Computer	5	
Numeracy		00
1. Solving Numerical Problems	00	
Practical Work		15
1. Course Laboratory	05	
2. Computer Laboratory	00	
3. Engineering Workshop/Course Workshop/Kitchen	10	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		50
1. Case Study Presentation	10	
2. Guest Lecture	00	
3. Industry/Field Visit	00	
4. Brain Storming Sessions	10	
5. Group Discussions		
6. Discussing Possible Innovations	30	
Term Tests, Laboratory Examination/Written Examination, Presentations		20
Total Duration in Hours		105

M.S. Ramaiah University of Applied Sciences * Bangalore

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the M. Pharm Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2 or SC3), COs are assessed as illustrated in the following Table.

	Component 1: Assignment (60% Weightage)	Component 2: Seminar (40% Weightage)
Subcomponent ▶	SC1	SC2
Subcomponent Type ▶	Assignment	Seminar
Maximum Marks ▶	60	40
CO-1	X	X
CO-2	X	
CO-3	X	
CO-4	X	X
CO-5		X

Component - 1: Assignment = 60Marks [4 courses of 15 marks each]
One word processed assignment submitted for 4 theory courses in a semester will be evaluated by Course Leaders for a maximum of 15 marks each.

Component - 2: Seminar = 40Marks [4 courses of 10 marks each]
Presentation on submitted assignments will be evaluated by Course Leaders for a maximum of 10 marks each.

Marks awarded for four individual Courses (Assignment -15 marks & Seminar – 10 marks) will be summed and calculated for the total marks obtained for a maximum mark of 100.

The assessment questions are set to test the learning outcomes. In each component a certain learning outcome are assessed. The following table illustrates the focus of learning outcome in each componentassessed:

Both components will be moderated by a second examiner.

Reassessment

1. If a student fails in the course, it is considered fail and he or she has to earn the credits inthe makeup opportunity and re-registration to the Course is required.

2. The maximum number of such opportunities is limited as per the academic regulations governing this Programme.

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

8. Achieving COs

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Reading and findings
2.	Understanding	Reading and findings
3.	Critical Skills	Literature Review
4.	Analytical Skills	Data collection
5.	Problem Solving Skills	Data analysis
6.	Practical Skills	Writing & Presentation
7.	Group Work	Data analysis
8.	Self-Learning	Reading and findings
9.	Written Communication Skills	Assignment processing
10.	Verbal Communication Skills	Presentation
11.	Presentation Skills	Presentation
12.	Behavioral Skills	Interactions
13.	Information Management	Paper writing
14.	Personal Management	Course work
15.	Leadership Skills	Effective management of learning, time management, achieving the learning

M.S. Ramaiah University of Applied Sciences * Bangalore - 560054 *

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

9. Course Resources

f. Essential Reading
   1. Research articles
   2. Relevant text books
   3. Visits to websites relevant to assignment problem

g. Recommended Reading

   NA

h. Magazines and Journals

   Relevant Magazines and Journals pertaining to assignment

i. Websites

   Specific web information pertaining to assignment

j. Other Electronic Resources

   NA

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

SEMESTER - III

Course Specifications: Research Methodology and Biostatistics

Course Title	Research Methodology and Biostatistics
Course Code	PCF613
Course Type	Core Theory Course
Department	Pharmaceutical Chemistry
Faculty	Pharmacy

1. Course Summary

This course deals with the basic principles of research methodology and medical research. The students are trained on statistical tools and methodologies to solve problem arising in medical research. The course will also impart students the guidelines for quality maintenance of laboratory animals for conducting biomedical research.

2. Course Size and Credits:

Number of Credits	04
Credit Structure (Lecture: Tutorial: Practical)	4:0:0
Total Hours of Interaction	60
Number of Weeks in a Semester	15
Department Responsible	Pharmacognosy & Pharmacy Practice
Total Course Marks	100 **Component 1: 25 Marks** 1A: Attendance: 8 Marks 1B: Student-Teacher interaction: 2 Marks 1C: Sessional Exam: 15 Marks **Component 2 (SEE):** Semester End Examination: 75 Marks
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-1.** Recognize the value, scope, objective and requirements of research
- **CO-2.** Discuss the basic concept and importance of statistical analysis
- **CO-3.** Outline the basic principles of medical research
- **CO-4.** Summarize the guidelines for the maintenance of laboratory animals
- **CO-5.** Perform the profession of Pharmacy with code of conduct and ethics
- **CO-6.** Apply the principles of medical research for the development of knowledge in the field of medicine

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

4. Course Contents

Unit 1

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

12 Hours

Unit 2

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

12 Hours

Unit 3

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.

12 Hours

Unit 4

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

12 Hours

Unit 5

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

Practical/Laboratory content: NA

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)											Programme Specific Outcomes (PSOs)			
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PSO-1	PSO-2	PSO-3	PSO-4
CO-1	3										2	3	2		
CO-2	3		3	2							2	2			1
CO-3	3		2				2					2			1
CO-4	3						2					2			
CO-5	2						3				1	2	2		2
CO-6	2		2	1			2	2				3	2		2
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution															

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		55
Demonstrations		00
1.Demonstration using Videos		
2. Demonstration using Physical Models / Systems		
3. Demonstration on a Computer		
Tutorials		00
Practical Work		
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		05
1. Case Study Presentation	00	
2. Guest Lecture	02	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	03	
6. Discussing Possible Innovations	00	
Written Examination		05
Total Duration in Hours		**65**

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the M.Pharm Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document. The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2 or SC3), COs are assessed as illustrated in the following Table.

Focus of COs on each Component or Subcomponent of Evaluation				
	Component 1: CE (25% Weightage)			Component 2: SEE (75% Weightage)
Subcomponent ▶	SC1	SC2	SC3	
Subcomponent Type ▶	Attendance	Student – Teacher Interaction	Sessional Exam	Semester End Examination 75 Marks
Maximum Marks ▶	8	2	15	
CO-1		X	X	X
CO-2		X	X	X
CO-3		X	X	X
CO-4		X	X	X
CO-5		X	X	X
CO-6		X	X	X
The details of SC1, SC2, SC3 are presented in the Programme Specifications Document.				

Component - 1: 25 marks

The marks allocated for Continuous mode of internal assessment shall be awarded as per the scheme given below:

Criteria	Maximum Marks
Attendance*	8
Student-Teacher Interaction	2
Total	10

1A. Guidelines for the allotment of marks for attendance*

Percentage of Attendance Theory	Marks
95 – 100	8
90 – 94	6
85 – 89	4
80 – 84	2
Less than 80	0

1B. Student-Teacher interaction

1C. Sessional exam: Two sessional exams (each for 30 marks) of 1 hour duration will be conducted, one at the end of 6th week and the other at the end of the 12th week. The average of the 2 sessional marks reduced to 15 will be the marks scored in the Sessional Examination

Component - 2: 75 marks

A 3 hour duration Semester End Examination will be conducted for maximum marks of 75. Both components will be evaluated by a second examiner.

Re-assessment

1. A student who fails to secure a minimum 50% in component-1 and 2 put together will be asked to register for Supplementary examination.
2. A student who has not satisfied the attendance requirement (not eligible for SEE) shall have to appear for Supplementary examination.
3. The maximum number of such opportunities are limited and as per the academic regulations governing this Programme.

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Class room lectures, Assignments
2.	Understanding	Class room lectures, Assignments
3.	Critical Skills	Class room lectures, Student-Teacher interaction, Assignments
4.	Analytical Skills	Student-Teacher Interaction
5.	Problem Solving Skills	Class room lectures, Examination and Assignments
6.	Practical Skills	--
7.	Group Work	Assignments
8.	Self-Learning	Assignment
9.	Written Communication Skills	Assignment, Examination, Student-Teacher Interaction
10.	Verbal Communication Skills	Presentations, Student-Teacher Interaction
11.	Presentation Skills	Class room activity, Assignment, Examination
12.	Behavioral Skills	Course work
13.	Information Management	Group discussions and presentations, preparation for examination and presentations
14.	Personal Management	Course work
15.	Leadership Skills	Handling questions during presentations, class room behavior with peers, Student-Teacher interaction

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

9. Course Resources

a. Essential Reading

1. Course notes
2. Booth W. C, Colomb and Williams, G.G (2005) The Craft of Research, Chicago University Press.
3. Willium M.K and Trochim. (2003) Research Methods, 2nd ed, Biztantra Publications
4. Jonathan Grix. (2004) The Foundation of Research, Palgrave Study Guides
5. Bolton S and Bon C (2009) Pharmaceutical Statistics - Practical & Clinical Applications. 5th ed.New York: Marcel Dekker.
6. Jagadeesh, G., Sreekant Murthy, Gupta Y.K., Amitabh Prakash (2010) Biomedical Research, Lippincott Williams and Wilkins, 1ST ed, New Delhi.
7. Gupta S.K. (2007) Basic principles of clinical Research and methodology, Institute of Clinical Research, India.
8. Ghosh M.N,(2008) Fundamentals of experimental Pharmacology, 4th ed, Hilton and company, Kolkata.

b. Recommended Reading

1. Muth, J.E.D. (2006) Basic Statistics and Pharmaceutical Statistical Applications, 2nd ed. New Delhi:CRC Press.
2. Jones, D.S. (2002) Pharmaceutical Statistics. UK: Pharmaceutical Press.
3. Himanshi Joshi, (2015) An alternative approach to experimental Pharmacology. India: Himdeep publication.

c. Magazines and Journals

1. Indian Journal of Medical Research- ICMR, India.
2. The International Journal of Biostatistics-Berkeley Electronic Press, United States.
3. Indian Journal of Pharmacology- Med know Publication, India

d. Websites

1. www.sciencedirect.com
2. www.pubmed.com

M.S. Ramaiah University of Applied Sciences * Bangalore - 560054 *

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

Course Specifications: Journal Club

Course Title	Journal Club
Course Code	PCF614
Course Type	Core Course
Department	Pharmaceutical Chemistry
Faculty	Pharmacy

1. Course Summary

The aim of this course is to equip a student to critically appraise the research article published in reputed journals. Students are trained for inquiry based learning and critical thinking skills. Students will also be trained to access journals adopting search engines and made to choose a topic of interest, collect relevant data, analyze and assess the quality of scientific paper and comment on the internal and external validity of the findings. Student will be able to base their opinion on evidence-based literature

2. Course Size and Credits:

Number of Credits	01
Credit Structure (Lecture: Tutorial: Practical)	1:0:0
Total Hours of Interaction	15
Number of Weeks in a Semester	15
Department Responsible	Pharmaceutical Chemistry
Total Course Marks	**Total Marks: 25** **Component 1: 15 Marks** Report Evaluation: 15 marks **Component 2: 10 Marks** Presentation: 10 marks
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-1.** Select scientific articles from reputed journals
- **CO-2.** Use search engines to select scientific articles
- **CO-3.** Critically appraise scientific articles and assess the quality
- **CO-4.** Develop a report on the critically appraised article
- **CO-5.** Present the critically appraised article in appropriate forum

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

4. Course Contents

- Select scientific articles from reputed journals
- Use search engines to select scientific articles
- Critically appraise scientific articles and assess the quality
- Develop a report on the critically appraised article
- Present the critically appraised article in appropriate forum

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)											Programme Specific Outcomes (PSOs)			
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PSO-1	PSO-2	PSO-3	PSO-4
CO-1	3														
CO-2	1			3							3				
CO-3	3		3								3	3			3
CO-4	3	3	3		3		2	3			3			3	3
CO-5	3	3	2	3	3		2	3			3			3	3
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution															

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		00
Demonstrations		00
1. Demonstration using Videos		
2. Demonstration using Physical Models / Systems		
3. Demonstration on a Computer		
Tutorials		00
Practical Work		00
1. Course Laboratory		
2. Computer Laboratory		
3. Engineering Workshop / Course/Workshop / Kitchen		
4. Clinical Laboratory		
5. Hospital		
6. Model Studio		
Others		15
1. Case Study Presentation	05	
2. Guest Lecture		
3. Industry / Field Visit		
4. Brain Storming Sessions	10	
5. Group Discussions		
6. Discussing Possible Innovations		
Report preparation/ Report Evaluation & Presentation		05
Total Duration in Hours		**20**

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the M. Pharm Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

Focus of COs on each Component or Subcomponent of Evaluation		
	Component 1: Report evaluation (15% Weightage)	Component 2: Presentation (10% Weightage)
Subcomponent Type ▶	Report Evaluation	Presentation
Maximum Marks ▶	15	10
CO-1	X	
CO-2	X	
CO-3	X	
CO-4	X	
CO-5		X

Component - 1: 15 marks
Report submitted will be evaluated by a committee of examiners consisting not less than 2 members with in the Department appointed by the Head of the Department in consultation with the Academic Registrar of the Faculty

Component - 2: 10 marks
Evaluation of presentation by a committee of examiners consisting not less than 2 members within the Department appointed by the Head of the Department in consultation with the Academic Registrar of the Faculty.
Both components will be moderated by a second examiner.

Re-assessment
1. If a student fails in the course, it is considered fail and he /she has to re-register in the next opportunity. The marks awarded will be recapped to 50%.
2. The maximum number of such opportunities are limited and as per the academic regulations governing this Programme.

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Reading
2.	Understanding	Reading
3.	Critical Skills	Review on Seminar topic
4.	Analytical Skills	Comments on the reviewed topic
5.	Problem Solving Skills	---
6.	Practical Skills	---
7.	Group Work	---
8.	Self-Learning	Reading and Research
9.	Written Communication Skills	Paper writing
10.	Verbal Communication Skills	Presentation
11.	Presentation Skills	Presentation
12.	Behavioral Skills	Interactions
13.	Information Management	Paper writing
15.	Leadership Skills	Effective management of learning, time management, achieving the learning outcomes

9. Course Resources

f. Essential Reading

Jennifer Raff, 2013, How to read and understand a scientific paper: A guide for non- scientists.

b. Recommended Reading

Relevant articles pertaining to the programme domain

c. Magazines and Journals

Relevant magazines and journals pertaining to the programme domain

d. Websites

1. www.sciencedirect.com
2. www.elsevier.com

M.S. Ramaiah University of Applied Sciences * Bangalore - 560054 *

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

Course Specifications: Group Project

Course Title	Group Project
Course Code	PCF615
Department	Pharmaceutical Chemistry
Faculty	Pharmacy

1. Course Summary

This course will focus on the applications of appropriate methods and techniques involved in pharmaceutical Sciences using relevant University resources for definition and execution of the project. The group project will enable the students to apply the theoretical and practical aspects of pharmaceutical sciences as well as project management techniques taught during the programme. This course will enable the students to gain practical experience of working in a project mode, requiring interactions with the domain specialist to meet the technical challenges

2. Course Size and Credits:

Number of Credits	04
Total Hours of Interaction	NA
Number of Weeks in a Semester (Lecture: Tutorial: Practical)	NA
Department Responsible	Department of Pharmacognosy, Pharmaceutical Chemistry, Pharmacology, Pharmaceutics, Pharmacy Practice
Total Course Marks	NA
Pass Criterion	Report Submission, Presentation & Exhibition of the project
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-1.** Work in a team and undertake a project in the area of Pharmaceutical Sciences
- **CO-2.** Apply concepts of pharmaceutical sciences for executing the project
- **CO-3.** Apply appropriate research methodology while formulating a project
- **CO-4.** Generate specifications, synthesize, analyse, develop and evaluate a project
- **CO-5.** Defend the project, exhibit, make a presentation and document the work

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

4. Course Contents

Unit 1

Need for undertaking a project, Project design, protocol / specifications design, methodology, analysis, product/design/model evaluation and presentation

Unit 2

Project Management, Time Management, Resource Management

Unit 3

Project Material indent, Project Development, Testing, Project Evaluation

Unit 4

Project Exhibition, Presentation

Unit 5

Team building, Team work, Leadership skills

Unit 6

Practical/Laboratory content: Interdepartmental laboratory work

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)											Programme Specific Outcomes (PSOs)			
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PSO-1	PSO-2	PSO-3	PSO-4
CO-1	3	3	2	2	1	1	1	2	1		1	3	3	2	1
CO-2	3	3	2	2	2	1	1	1	1		2	3	2	2	1
CO-3	3	3	3	3	2	1	1	1	1	1	1	3	3	2	1
CO-4	2	2	3	1	3	2	1	1	1	1	1	3	3	2	1
CO-5	3	3	3	3	2	1	1	3	3	1	1	3	3	2	1
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution															

M.S. Ramaiah University of Applied Sciences * Bangalore - 560054 *

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		00
Demonstrations		00
1. Demonstration using Videos	00	
2. Demonstration using Physical Models / Systems	00	
3. Demonstration on a Computer		
Tutorials		00
Practical Work		
1. Course Laboratory	00	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		00
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Written Examination		00
Total Duration in Hours		**NA**

7. Course Assessment and Reassessment

There are two components for assessment in this course

Focus of COs on each Component or Subcomponent of Evaluation		
	Component 1: Project report and viva voce (15% Weightage)	Component 2: Exhibition and Presentation (10% Weightage)
Subcomponent Type ▶	Project report and viva voce	Exhibition and Presentation
Maximum Marks ▶	15	10
CO-1	X	X
CO-2	X	X
CO-3	X	X
CO-4	X	X
CO-5	X	X

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

Component - 1: 50% weight
Project Report and Viva-Voce
Component - 2: 50% weight
Exhibition and Presentation
Both components will be moderated by a second examiner and the credits will be awarded after satisfying completion of the project work.
Reassessment
If a student fails in any one of the components, it is considered fail and the student should resubmit the project report or re-register to the course as applicable.
The maximum number of such opportunities is limited as per the academic regulations governing this course.

8. Meeting Programme Objectives through Course Objectives

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Group Project Work
2.	Understanding	Group Project Work
3.	Critical Skills	Group Project Work
4.	Analytical Skills	Group Project Work
5.	Problem Solving Skills	Group Project Work
6.	Practical Skills	Group Project Work
7.	Group Work	Group Project Work
8.	Self-Learning	Group Project Work
9.	Written Communication Skills	Report writing
10.	Verbal Communication Skills	Presentation
11.	Presentation Skills	Presentation
12.	Behavioral Skills	Group Project Work
13.	Information Management	Group Project Work
14.	Personal Management	Group Project Work
15.	Leadership Skills	Effective management of learning, time management, achieving the learning outcomes

9. **Course Resources**

a. Essential Reading
Assigned reading relevant to the group project.
b. Recommended Reading
Assigned reading relevant to the group project.
c. Magazines and Journals
Specific Journals relevant to group project work
d. Websites
Specific Websites relevant to group project work

M.S. Ramaiah University of Applied Sciences * Bangalore - 560054 *

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

Course Specifications: Discussion / Synopsis Presentation

Course Title	Discussion / Synopsis Presentation
Course Code	PCF616
Course Type	Core Theory Course
Department	Pharmaceutical Chemistry
Faculty	Pharmacy

1. Course Summary

This course is designed to impart knowledge on the area of advances in targeted drug delivery systems. The coursed also focuses on molecular mechanistic approaches to the development of bio-available drugs and delivery systems.

2. Course Size and Credits:

Number of Credits	02
Credit Structure (Lecture: Tutorial: Practical)	2:0:0
Total Hours of Interaction	02
Number of Weeks in a Semester	15
Department Responsible	Pharmaceutical Chemistry
Total Course Marks	50
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO-1. Identify Research problem
CO-2. Discuss research problem with team and peers for solution
CO-3. Develop a protocol report on the critically appraised research problem
CO-4. Present the critically appraised research problem in appropriate forum

M.S. Ramaiah University of Applied Sciences * Bangalore - 560054 *

4. Course Contents

Unit 1

Collect and appraise the relevant data from the scientific article for the chosen research problem.
Record the findings/data for solving research problem.
Develop a report on the critical observations and discuss with mentor /peer.
Presentation of the reports/findings in appropriate forum.
Practical/Laboratory content: NA.

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)											Programme Specific Outcomes (PSOs)			
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PSO-1	PSO-2	PSO-3	PSO-4
CO-1	3	1	3						3	2		3	1	3	2
CO-2	3	1	1		2	2		3			2	2	1	2	
CO-3	3	3	3	2			2		2	2	3	3	3	3	2
CO-4	3	1			3	3		3			2	2	1	2	2
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution															

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		20
Demonstrations		10
1. Demonstration using Videos	5	
2. Demonstration using Physical Models / Systems		
3. Demonstration on a Computer	5	
Tutorials		00
Practical Work		00
1. Course Laboratory		
2. Computer Laboratory		
3. Engineering Workshop / Course/Workshop / Kitchen		
4. Clinical Laboratory		
5. Hospital		
6. Model Studio		
Others		00
1. Case Study Presentation		
2. Guest Lecture		
3. Industry / Field Visit		
4. Brain Storming Sessions	05	
5. Group Discussions		
6. Discussing Possible Innovations	20	
Synopsis preparation/ Presentation/ Discussion		05
Total Duration in Hours		**35**

7. Course Assessment and Reassessment

Synopsis to be evaluated along with the supporting documents by the Head of the Department/ Nominated Examiner by the HoD/Academic Registrar/Dean. Panel to evaluate and endorse. Dean of the Faculty to approve and submit to the University.

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

Re-assessment

The remarks/queries/suggestions made by the examiner during scrutiny of the synopsis should be attended by the candidate in consultation with the Research Supervisor and must be re-submitted for evaluation process

Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Reading
2.	Understanding	Reading
3.	Critical Skills	Review on research topic
4.	Analytical Skills	Comments on reviewed topic
5.	Problem Solving Skills	Research work, discussion
6.	Practical Skills	Research work, interactions
7.	Group Work	Discussion
8.	Self-Learning	Reading and Research
9.	Written Communication Skills	Report writing
10.	Verbal Communication Skills	Presentation
11.	Presentation Skills	Presentation
12.	Behavioral Skills	Interactions
13.	Information Management	Document writing and Presentation
14.	Personal Management	Presentation
15.	Leadership Skills	Effective management of learning, time management, achieving the learning outcomes

9. Course Resources

a. Essential Reading

1. Jennifer Raff, 2013, *How to read and understand a scientific paper: A guide for non-scientists.*

b. Magazines and Journals

1. International Journal of Pharmaceutics, Elsevier, ScienceDirect, Amsterdam
2. European Journal of Pharmaceutical Sciences, Elsevier, ScienceDirect, Amsterdam
3. Advanced Drug Delivery Reviews, Elsevier, ScienceDirect, Amsterdam
4. Journal of Controlled Release, Elsevier, ScienceDirect, Amsterdam
5. Drug Development and Industrial Pharmacy, Informa UK
6. Asian Journal of Pharmaceutical Sciences, Elsevier, ScienceDirect, Amsterdam
7. Indian Journal of Pharmaceutical Sciences, Indian Pharmaceutical Association, Mumbai

c. Websites

1. www.sciencedirect.com
2. www.elsevier.com

M.S. Ramaiah University of Applied Sciences

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

Course Specifications: Research Work

Course Title	Research Work
Course Code	PCF617
Course Type	Core Research Course
Department	Pharmaceutical Chemistry
Faculty	Pharmacy

1. Course Summary

The aim of this course is to encourage students to develop skills in identification of a research problem in the chosen domain. This course also emphasizes the application of principles of research methodology, preparation of research project proposal, research project management, execution of research project with effective technical documentation and presentation.

2. Course Size and Credits:

Number of Credits	14
Credit Structure (Lecture: Tutorial: Practical)	0:0:14
Total Hours of Interaction	28
Number of Weeks in a Semester	15
Department Responsible	Pharmaceutical Chemistry
Total Course Marks	**Total Marks: 350** **Component -1: 250 Marks** Evaluation of Interim-Dissertation work Progress **Component -2: 100 Marks** Evaluation of Interim-Dissertation Presentation
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO-1. Review scholarly literature collected from various sources critically for the project and formulate aresearch problem
CO-2. Prepare and present a research proposal
CO-3. Conduct research to achieve research objectives
CO-4. Propose new ideas/ methodologies or procedures for further improvement of the research problem
CO-5. Create research document of the findings
CO-6. Defend the research findings in front of scholarly audience

M.S. Ramaiah University of Applied Sciences * Bangalore - 560054 *

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

4. **Course Contents**

- Information search, retrieval and review
- Research problem identification
- Project definition and project planning with objectives
- Use of conceptual models/methodologies and frameworks
- Problem solving and evaluation
- Interpretations and drawing conclusions
- Proposing ideas or methods for further work
- Dissertation writing
- Oral presentation

Practical/Laboratory content: Yes

5. **Course Map (CO-PO-PSO Map)**

	Programme Outcomes (POs)											Programme Specific Outcomes (PSOs)			
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PSO-1	PSO-2	PSO-3	PSO-4
CO-1	3	2	2	2			3	2		1	3	3	2		2
CO-2	3	2	3	2	2	2	3	2		1	2	3	2	2	2
CO-3	3	2	3	2		2	3	2	3	1	3	3	2		2
CO-4	3	2	3	3	2	2	3	2	2	1	3	3	3	2	2
CO-5	3	2	2	3		2	3	2		1	3	3	3		2
CO-6	3	2	3	2	2	3	3	2	3	1	3	3	3	2	2
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution															

M.S.Ramaiah University of Applied Sciences * Bangalore

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		00
Demonstrations		
1.Demonstration using Videos		
2. Demonstration using Physical Models / Systems		
3. Demonstration on a Computer		
Tutorials		00
Practical Work		
1. Course Laboratory	25	
2. Computer Laboratory	03	
3. Engineering Workshop / Course/Workshop / Kitchen	00	28
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	00
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Presentation Evaluation		02
Total Duration in Hours		30

M.S. Ramaiah University of Applied Sciences Bangalore - 560054

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the M. Pharm Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2 or SC3), COs are assessed as illustrated in the following Table.

Focus of Cos on each Component or Subcomponent of Evaluation		
	Component 1: CE (250 Marks)	Component 2: SEE (100 Marks)
CO-1	X	X
CO-2	X	X
CO-3	X	X
CO-4	X	X
CO-5	X	⊘
CO-6	X	⊘

Component - 1: Evaluation of Dissertation Book

Objectives	25 Marks
Review of literature	25 Marks
Methodology – Preliminary and on-going, evaluation parameters	100 Marks
Results and Discussion	100 Marks
Total	**250 Marks**

Component - 2: Evaluation of Dissertation Presentation

Presentation of work	50 Marks
Communication skills	25 Marks
Question and answer skills	25 Marks
Total	**100 Marks**

The components will be evaluated by two examiners, one would be the Guide/ Supervisor (Internal Examiner) and the other External examiner would be the senior faculty member (within Department/Faculty for Component-1 & outside external to the University for Component-2.

However, the process of Dissertation evaluation in the IV semester should be carried out only after the student passes all the courses till III semester.

Re-assessment

1. If a student fails in the course, it is considered fail and re-registration to the course is required
2. The maximum number of such opportunities is limited as per the academic regulationsgoverning this programme.

Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.
Course reassessment policies are presented in the Academic Regulations document.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Dissertation
2.	Understanding	Dissertation
3.	Critical Skills	Dissertation
4.	Analytical Skills	Dissertation
5.	Problem Solving Skills	Dissertation
6.	Practical Skills	Dissertation
7.	Group Work	Dissertation
8.	Self-Learning	Dissertation
9.	Written Communication Skills	Report writing
10.	Verbal Communication Skills	Presentation
11.	Presentation Skills	Presentation
12.	Behavioral Skills	Presentation
13.	Information Management	Report writing and Presentation
14.	Personal Management	Report writing and Presentation
15.	Leadership Skills	Effective management of learning, time management, achieving the learning outcome

9. Course Resources

c. Essential Reading

1. Barry White, 2011, *Mapping Your Thesis: The Comprehensive Manual of Theory andTechniques for Masters and Doctoral Research*, ACER press, Australia.
2. Maximiano M. Rivera, Jr. and Roela Victoria Rivera, 2007, *Practical Guide to Thesis andDissertation Writing*, KATHA Publishing, Philippines.
3. Lecture sessions on Dissertation, Thesis preparation delivered by the concerned Head of theDept.

d. Recommended Reading

Relevant books pertaining to research problem

e. Magazines and Journals

Relevant magazines and journals pertaining to research problem

f. Websites

Relevant websites pertaining to research problem

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

SEMESTER - IV

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Course Specifications: Journal Club

Course Title	Journal Club
Course Code	PCF618
Course Type	Core Course
Department	Pharmaceutical Chemistry
Faculty	Pharmacy

1. Course Summary

The aim of this course is to equip a student to critically appraise the research article published in reputed journals. Students are trained for inquiry based learning and critical thinking skills. Students will also be trained to access journals adopting search engines and made to choose a topic of interest, collect relevant data, analyze and assess the quality of scientific paper and comment on the internal and external validity of the findings. Student will be able to base their opinion on evidence-based literature

2. Course Size and Credits:

Number of Credits	01
Credit Structure (Lecture: Tutorial: Practical)	1:0:0
Total Hours of Interaction	15
Number of Weeks in a Semester	15
Department Responsible	Pharmaceutical Chemistry
Total Course Marks	**Total Marks: 25** **Component 1: 15 Marks** Report Evaluation: 15 marks **Component 2: 10 Marks** Presentation: 10 marks
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-1.** Select scientific articles from reputed journals
- **CO-2.** Use search engines to select scientific articles
- **CO-3.** Critically appraise scientific articles and assess the quality
- **CO-4.** Develop a report on the critically appraised article
- **CO-5.** Present the critically appraised article in appropriate forum

M.S. Ramaiah University of Applied Sciences * Bangalore - 560054 *

Dean - Academics
M.S. Ramaiah University of Applied Sciences

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

4. **Course Contents**
   - Select scientific articles from reputed journals
   - Use search engines to select scientific articles
   - Critically appraise scientific articles and assess the quality
   - Develop a report on the critically appraised article
   - Present the critically appraised article in appropriate forum

5. **Course Map (CO-PO-PSO Map)**

	Programme Outcomes (POs)											Programme Specific Outcomes (PSOs)			
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PSO-1	PSO-2	PSO-3	PSO-4
CO-1	3														
CO-2	1			3							3				
CO-3	3		3								3	3			3
CO-4	3	3	3		3		2	3			3			3	3
CO-5	3	3	2	3	3		2	3			3			3	3
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution															

6. **Course Teaching and Learning Methods**

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		00
Demonstrations		00
1. Demonstration using Videos		
2. Demonstration using Physical Models / Systems		
3. Demonstration on a Computer		
Tutorials		00
Practical Work		00
1. Course Laboratory		
2. Computer Laboratory		
3. Engineering Workshop / Course/Workshop / Kitchen		
4. Clinical Laboratory		
5. Hospital		
6. Model Studio		
Others		10
1. Case Study Presentation		
2. Guest Lecture		
3. Industry / Field Visit		
4. Brain Storming Sessions	10	
5. Group Discussions		
6. Discussing Possible Innovations		
Report preparation/ Report Evaluation & Presentations		05
	Total Duration in Hours	**15**

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the M. Pharm Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

Focus of COs on each Component or Subcomponent of Evaluation		
	Component 1: Report evaluation (15% Weightage)	Component 2: Presentation (10% Weightage)
Subcomponent Type ▶	Report Evaluation	Presentation
Maximum Marks ▶	15	10
CO-1	⊘	
CO-2	⊘	
CO-3	⊘	
CO-4	⊘	
CO-5		⊘

Component - 1: 15 marks
Report submitted will be evaluated by a committee of examiners consisting not less than 2 members with in the Department appointed by the Head of the Department in consultation with the Academic Registrar of the Faculty

Component - 2: 10 marks
Evaluation of presentation by a committee of examiners consisting not less than 2 members within the Department appointed by the Head of the Department in consultation with the Academic Registrar of the Faculty.
Both components will be moderated by a second examiner.

Re-assessment
1. If a student fails in the course, it is considered fail and he /she has to re-register in the next opportunity. The marks awarded will be recapped to 50%.
2. The maximum number of such opportunities are limited and as per the academic regulations governing this Programme.

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.

Course reassessment policies are presented in the Academic Regulations document.

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Reading
2.	Understanding	Reading
3.	Critical Skills	Review on Seminar topic
4.	Analytical Skills	Comments on the reviewed topic
5.	Problem Solving Skills	---
6.	Practical Skills	---
7.	Group Work	---
8.	Self-Learning	Reading and Research
9.	Written Communication Skills	Paper writing
10.	Verbal Communication Skills	Presentation
11.	Presentation Skills	Presentation
12.	Behavioral Skills	Interactions
13.	Information Management	Paper writing
14.	Leadership Skills	Effective management of learning, time management, achieving the learning outcomes

9. Course Resources

a. Essential Reading

Jennifer Raff, 2013, How to read and understand a scientific paper: A guide for non-scientists.

b. Recommended Reading

Relevant articles pertaining to the programme domain

c. Magazines and Journals

Relevant magazines and journals pertaining to the programme domain

d. Websites

1. www.sciencedirect.com
2. www.elsevier.com

M.S. Ramaiah University of Applied Sciences * Bangalore - 560054 *

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Course Specifications: Discussion / Presentation

Course Title	Discussion / Presentation
Course Code	PCF619
Course Type	Core Theory Course
Department	Pharmaceutical Chemistry
Faculty	Pharmacy

1. Course Summary

The aim of this course is to enrich a student to critically solve the research problem/project proposal. Students will be trained to plan and execute the solution for the research problem through discussion and presentation with their mentor and peers using acquired knowledge, skills, evidence based literature and experience.

2. Course Size and Credits:

Number of Credits	03
Credit Structure (Lecture: Tutorial: Practical)	3:0:0
Total Hours of Class room and laboratory Interaction during the course	45
Number of Weeks in a Semester	15
Department Responsible	Pharmaceutical Chemistry
Course Marks	75
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-1.** Identify the research problem
- **CO-2.** Discuss research problem with team and peers for solution
- **CO-3.** Develop a protocol report on the critically appraised research problem
- **CO-4.** Present the critically appraised research problem in appropriate forum

4. Course Contents

Unit 1
Conduct of research work /Group Project in the laboratories and collection of data/findings
Unit 2
Record the findings/data for solving research problem with scientific based results
Unit 3
Develop a report on the critical observations and discuss with mentor /peer.
Unit 4
Investigation of medicinal Presentation of the reports/findings in appropriate forum).
Unit 5
Practical/Laboratory content: Research work in the Post Graduate Laboratories

M.S. Ramaiah University of Applied Sciences * Bangalore - 560054 *

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Dean
Faculty of Pharmacy
M. S. Ramaiah University of Applied Sciences
Bangalore - 54.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)											Programme Specific Outcomes (PSOs)			
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PSO-1	PSO-2	PSO-3	PSO-4
CO-1	3		3			3	2	3	2	2	2				3
CO-2	2	2	3	2	2	2	2	3	1	2	2			2	3
CO-3	3	3	3	3	2	2	2	3	2	2	3	3	3		3
CO-4	3	3	3	3	2	2	2	3	2	2	3	3	3	2	3
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution															

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		00
Demonstrations		05
1. Demonstration using Videos	05	
2. Demonstration using Physical Models / Systems		
3. Demonstration on a Computer		
Tutorials		
1. Solving Numerical Problems	05	05
Practical Work		25
1. Course Laboratory	00	
2. Computer Laboratory	20	
3. Engineering Workshop / Course/Workshop / Kitchen	05	
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		10
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	00	
4. Brain Storming Sessions	10	
5. Group Discussions	00	
6. Discussing Possible Innovations	05	
Written Examination / Presentation		05
Total Duration in Hours		**50**

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

Dean - Academics
M.S. Ramaiah University of Applied Sciences

7. Course Assessment and Reassessment

Process:

Log book of the research work/Group Project / Colloquium presentation to be evaluated along with the supporting documents by the Head of the Department/ Nominated Examiner by the HoD/Academic Registrar/Dean along with the Supervisor. Panel to evaluate and endorse. Dean of the Faculty to approve and submit to the University

Re-assessment

The remarks/queries/suggestions made by the examiner during discussion / colloquium should be attended by the candidate in consultation with the Research Supervisor and must be re-submitted for evaluation process.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Reading
2.	Understanding	Reading
3.	Critical Skills	Review on Seminar topic
4.	Analytical Skills	Comments on the reviewed topic
5.	Problem Solving Skills	Research work, discussion
6.	Practical Skills	Research work, Interactions
7.	Group Work	Discussion
8.	Self-Learning	Reading and Research
9.	Written Communication Skills	Report writing
10.	Verbal Communication Skills	Presentation
11.	Presentation Skills	Presentation
12.	Behavioral Skills	Interactions
13.	Information Management	Document writing and Presentation
14.	Leadership Skills	Effective management of learning, time management, achieving the learning outcomes

9. Course Resources

Essential Reading

a. Research Papers

b. Visits to websites relevant to research

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

Course Specifications: Research Work

Course Title	Research Work
Course Code	PCF620
Course Type	Core Research Course
Department	Pharmaceutical Chemistry
Faculty	Pharmacy

1. Course Summary

The aim of this course is to encourage students to develop skills in identification of a research problem inthe chosen domain. This course also emphasizes the application of principles of research methodology, preparation of research project proposal, research project management, execution of research project with effective technical documentation and presentation.

2. Course Size and Credits:

Number of Credits	16
Credit Structure (Lecture: Tutorial: Practical)	0:0:31
Total Hours of Interaction	31
Number of Weeks in a Semester	15
Department Responsible	Pharmaceutical Chemistry
Total Course Marks	**Total Marks: 400** **Component -1: 250 Marks** Evaluation of Final Dissertation Book **Component -2: 150 Marks** Evaluation of Final Dissertation Presentation
Pass Criterion	As per the Academic Regulations
Attendance Requirement	As per the Academic Regulations

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-1.** Review scholarly literature collected from various sources critically for the project and formulate aresearch problem
- **CO-2.** Prepare and present a research proposal
- **CO-3.** Conduct research to achieve research objectives
- **CO-4.** Propose new ideas/ methodologies or procedures for further improvement of the research problem
- **CO-5.** Create research document of the findings
- **CO-6.** Defend the research findings in front of scholarly audience

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

4. Course Contents

- Information search, retrieval and review
- Research problem identification
- Project definition and project planning with objectives
- Use of conceptual models/methodologies and frameworks
- Problem solving and evaluation
- Interpretations and drawing conclusions
- Proposing ideas or methods for further work
- Dissertation writing
- Oral presentation

Practical/Laboratory content: Yes

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)											Programme Specific Outcomes (PSOs)			
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PSO-1	PSO-2	PSO-3	PSO-4
CO-1	3	2	2	2			3	2		1	3	3	2		2
CO-2	3	2	3	2	2	2	3	2		1	2	3	2	2	2
CO-3	3	2	3	2		2	3	2	3	1	3	3	2		2
CO-4	3	2	3	3	2	2	3	2	2	1	3	3	3	2	2
CO-5	3	2	2	3		2	3	2		1	3	3	3		2
CO-6	3	2	3	2	2	3	3	2	3	1	3	3	3	2	2
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution															

M.S. Ramaiah University of Applied Sciences * Bangalore - 560054 *

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

6. Course Teaching and Learning Methods

Teaching and Learning Methods	Duration in hours	Total Duration in Hours
Face to Face Lectures		00
Demonstrations		
1.Demonstration using Videos		
2. Demonstration using Physical Models / Systems		
3. Demonstration on a Computer		
Tutorials		00
Practical Work		
1. Course Laboratory	28	
2. Computer Laboratory	00	
3. Engineering Workshop / Course/Workshop / Kitchen	00	430
4. Clinical Laboratory	00	
5. Hospital	00	
6. Model Studio	00	
Others		
1. Case Study Presentation	00	
2. Guest Lecture	00	
3. Industry / Field Visit	03	30
4. Brain Storming Sessions	00	
5. Group Discussions	00	
6. Discussing Possible Innovations	00	
Research Presentation		05
Total Duration in Hours		465

7. Course Assessment and Reassessment

The details of the components and subcomponents of course assessment are presented in the Programme Specifications document pertaining to the M.Pharm Programme. The procedure to determine the final course marks is also presented in the Programme Specifications document.

The evaluation questions are set to measure the attainment of the COs. In either component (CE or SEE) or subcomponent of CE (SC1, SC2 or SC3), COs are assessed as illustrated in the following Table.

Focus of Cos on each Component or Subcomponent of Evaluation		
	Component 1: CE (500 Marks)	**Component 2: SEE (250 Marks)**
CO-1	⦸	X
CO-2	X	X
CO-3	X	X
CO-4	X	X
CO-5	X	X
CO-6		X

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Component - 1: Evaluation of Dissertation Book

Methodology: Experimental work & Evaluation studies	50 Marks
Results & Discussion	150 Marks
Conclusion & final outcomes	50 Marks
Total	**250 Marks**

Component - 2: Evaluation of Dissertation Presentation

Presentation of work	50 Marks
Communication skills	50 Marks
Question and Answer skills	50 Marks
Total	**150 Marks**

The components will be evaluated by two examiners, one would be the Guide/ Supervisor (Internal Examiner) and the other External examiner would be the senior faculty member (within Department/Faculty for Component-1 & outside external to the University for Component-2.

However, the process of Dissertation evaluation in the IV semester should be carried out only after the student passes all the courses till III semester.

Re-assessment

1. If a student fails in the course, it is considered fail and re-registration to the course is required
2. The maximum number of such opportunities is limited as per the academic regulationsgoverning this programme.

The Course Leader assigned to the course, in consultation with the Head of the Department, shall provide the focus of COs in each component of assessment in the above template at the beginning of the semester.
Course reassessment policies are presented in the Academic Regulations document.

M.S. Ramaiah University of Applied Sciences * Bangalore - 560054 *

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Dissertation
2.	Understanding	Dissertation
3.	Critical Skills	Dissertation
4.	Analytical Skills	Dissertation
5.	Problem Solving Skills	Dissertation
6.	Practical Skills	Dissertation
7.	Group Work	Dissertation
8.	Self-Learning	Dissertation
9.	Written Communication Skills	Report writing
10.	Verbal Communication Skills	Presentation
11.	Presentation Skills	Presentation
12.	Behavioral Skills	Presentation
13.	Information Management	Report writing and Presentation
14.	Personal Management	Report writing and Presentation
15.	Leadership Skills	Effective management of learning, time management, achieving the learning outcome

9. Course Resources

a. Essential Reading

1. Barry White, 2011, *Mapping Your Thesis: The Comprehensive Manual of Theory andTechniques for Masters and Doctoral Research*, ACER press, Australia.
2. Maximiano M. Rivera, Jr. and Roela Victoria Rivera, 2007, *Practical Guide to Thesis andDissertation Writing*, KATHA Publishing, Philippines.
3. Lecture sessions on Dissertation, Thesis preparation delivered by the concerned Head of theDept.

b. Recommended Reading

Relevant books pertaining to research problem

c. Magazines and Journals

Relevant magazines and journals pertaining to research problem

d. Websites

Relevant websites pertaining to research problem

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Course Specifications: Participation/ Presentation in Research Forum

Course Title	Participation/ Presentation in Research Forum
Course Code	PCF621
Course Type	Mandatory Course
Department	Pharmaceutical Chemistry
Faculty	Pharmacy

1. Course Summary

The aim of this course is to make a student participate / present a research paper in a conference /seminar/workshop/symposium based on his/her research work specialization during his/her programme. The student is required to carry out original research, author a conference paper and present it. The student is also required to submit the paper to a conference approved by the department

2. Course Size and Credits:

Number of Credits	03 National level participation: 01 International level participation: 02
Credit Structure (Lecture: Tutorial: Practical)	NA
Total Hours of Interaction	NA
Number of Weeks in a Semester	NA
Department Responsible	Pharmaceutics, Pharmacognosy, Pharmaceutical Chemistry, Pharmacology, Pharmacy Practice
Total Course Marks	NA
Pass Criterion	As per the Academic Regulations
Attendance Requirement	NA

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

- **CO-1.** Identify a suitable conference /research forum/workshop/symposium for participation/presentation
- **CO-2.** Participation in a conference/research forum/workshop/symposium of the chosen research domain
- **CO-3.** Present a research work in the conference/research forum of the chosen research domain

M.S. Ramaiah University of Applied Sciences * Bangalore - 560054 *

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

4. Course Contents

Unit 1

Identification of suitable conference of research domain

Unit 2

Participation in a conference/symposium/workshop

Unit 3

Presentation of research work in a conference

Practical/Laboratory content: NA

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)											Programme Specific Outcomes (PSOs)			
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PSO-1	PSO-2	PSO-3	PSO-4
CO-1	3	2		1	2	2								1	
CO-2	3	3			3	3	2	3	2		1			2	1
CO-3	3	3	2	1		3	3	3		1	3	1	1	3	3
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution															

6. Course Teaching and Learning Methods

Self-Learning

Description	Number of credits
Participation in National Level Seminar/Conference / Workshop / Symposium / Training Programs (related to the specialization of the student)	01
Participation in outside India International Level Seminar /Conference / Workshop / Symposium / Training Programs (related to the specialization of the student)	02

7. Course Assessment and Reassessment

NA

Process: To be nominated by the Head of the department/Course Supervisor with the supporting documents. Panel to evaluate and endorse. Dean of the Faculty to approve the credit awarded and submit to the University.

Re-assessment

NA

Course reassessment policies are presented in the Academic Regulations document.

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

Dean Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

8. Achieving COs

The following skills are directly or indirectly imparted to the students in the following teaching and learning methods:

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Reading and Research
2.	Understanding	Reading and Research
3.	Critical Skills	Literature Review
4.	Analytical Skills	Research
5.	Problem Solving Skills	Research
6.	Practical Skills	Research
7.	Group Work	Data analysis
8.	Self-Learning	Reading and Research
9.	Written Communication Skills	Paper writing
10.	Verbal Communication Skills	Presentation
11.	Presentation Skills	Presentation
12.	Behavioral Skills	Interactions
13.	Information Management	Paper writing
14.	Leadership Skills	Effective management of learning, time management, achieving the learning outcomes

9. Course Resources

e. **Class Notes**

f. **Essential Reading**

a. Research Papers

b. Visits to websites relevant to research

c. **Websites**

1. www.sciencedirect.com
2. www.elsevier.com

M.S. Ramaiah University of Applied Sciences * Bangalore - 560054 *

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

Course Specifications: Publication: National/International Journals

Course Title	Publication: National/ International
Course Code	PCF622
Course Type	Core Course
Department	Pharmaceutical Chemistry
Faculty	Pharmacy

1. Course Summary

The aim of this course is to make a student submit a research paper to a journal based on his/her research work during the programme. The student is required to carry out original research or explicit review of an article, author a journal paper for publication. The student is required to submit the research paper to a journal approved by the department.

2. Course Size and Credits

Number of Credits	Scopus indexed National Journal: 01 Scopus indexed International Journal: 02
Credit Structure (Lecture: Tutorial: Practical)	NA
Total Hours of Interaction	NA
Number of Weeks in a Semester	NA
Department Responsible	Pharmaceutical Chemistry
Total Course Marks	NA
Pass Criterion	Acceptance of research work manuscript in a Scopus indexed journal
Attendance Requirement	NA

3. Course Outcomes (COs)

After the successful completion of this course, the student will be able to:

CO-1. Write a research paper based on research and journal requirements
CO-2. Publish the research work manuscript in a reputed journal

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

4. Course Contents

Identify a suitable journal for research publication
Collection, presentation and analysis of relevant research data
Preparation of manuscript according to the Journal instructions
Submission of manuscript for publication and further review
Practical/Laboratory content: NA

5. Map (CO-PO-PSO Map)

	Programme Outcomes (POs)											Programme Specific Outcomes (PSOs)			
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PSO-1	PSO-2	PSO-3	PSO-4
CO-1	3	2	1	2		1		3			2	2	2	1	2
CO-2	3	2	1	2		1		3	1	2	2	2	2	1	2
3: Very Strong Contribution, 2: Strong Contribution, 1: Moderate Contribution															

6. Course Teaching and Learning Methods

Self-Directed

Description	Number of credits
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

7.Course Assessment and reassessment

NA

Process: To be nominated by the Head of the department/Course Supervisor with the supporting documents. Panel to evaluate and endorse. Dean of the Faculty to approve the credit awarded and submit to the University.

Reassessment

NA

M.S. Ramaiah University of Applied Sciences * Bangalore - 560054 *

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

8. Achieving COs

S. No	Curriculum and Capabilities Skills	How imparted during the course
1.	Knowledge	Reading and Research
2.	Understanding	Reading and Research
3.	Critical Skills	Literature Review
4.	Analytical Skills	Research
5.	Problem Solving Skills	Research
6.	Practical Skills	Research
7.	Group Work	Data analysis
8.	Self-Learning	Reading and Research
9.	Written Communication Skills	Paper writing
10.	Verbal Communication Skills	Presentation
11.	Presentation Skills	Presentation
12.	Behavioral Skills	Interactions
13.	Information Management	Paper writing
14.	Personal Management	Course work
15.	Leadership Skills	Effective management of learning ,time management, achieving the learning outcomes

9. Course Resources

a. Essential Reading

1. Research Papers/Publications from reputed journals
2. Visits to websites relevant to research

M.S. Ramaiah University of Applied Sciences * Bangalore - 560054 *

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Course Specifications: Academic/Research Award

Course Title	Academic/Research Award
Course Code	PCF623
Course Type	Mandatory Course
Department	Pharmaceutical Chemistry
Faculty	Pharmacy

1. Course Summary

The students with extraordinary academic achievement/ research accomplishment are provided an opportunity to utilize in a State/National / International awarding agencies or platforms as a means to further encourage sound scholarship. The students are trained to develop required documents like statement of purpose and resume and also developing concept note / abstract of their accomplishment.

2. Course Size and Credits:

Number of Credits	State/National agency awarded : 01 International agency awarded : 02
Credit Structure (Lecture: Tutorial: Practical)	NA
Total Hours of Interaction	NA
Number of Weeks in a Semester	NA
Department Responsible	Pharmacognosy, Pharmaceutical Chemistry, Pharmaceutics, Pharmacology, Pharmacy Practice
Total Course Marks	NA
Pass Criterion	Certificate of Excellence Award from the appropriate agency
Attendance Requirement	NA

3. Course Outcomes (COs)

- **CO-1.** Synthesize the academic accomplishments /research findings in the form of report
- **CO-2.** Identify an appropriate award granting agency to submit the report
- **CO-3.** Develop required documents applicable to submit the academic accomplishment / research report

4. Course Contents

Skill of developing report on the content of their domain for academic achievement/ research accomplishment.
Technical communication skills for submission of the documents /records for the award.
Practical/Laboratory content: NA

M.S. Ramaiah University of Applied Sciences * Bangalore - 560 054 *

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

5. Course Map (CO-PO-PSO Map)

	Programme Outcomes (POs)											Programme Specific Outcomes (PSOs)			
	PO -1	PO -2	PO -3	PO -4	PO -5	PO -6	PO -7	PO -8	PO -9	PO -10	PO -11	PSO -1	PSO -2	PSO -3	PSO -4
CO-1	3	2	3	1			1	2			1	3	1		
CO-2		3	3		1			3			1			3	2
CO-3		2				1		1		1	1				3

6. Course Teaching and Learning Methods

Self-directed

Description	Number of credits
Academic /Research award from State/National level agencies	01
Academic/Research award from International level agencies	02

7. Course Assessment and Reassessment

Process: To be nominated by Head of the department/ Course Supervisor with supporting documents. Constitution panel will evaluate and endorse the application. Dean of faculty to approve nomination and submit to the University.

8. Achieving COs

NA

9. Course Resources

a. Essential Reading

i. Richard J Stelzer, 2002, How to write winning personal statement of purpose for graduate and professional school, 3rd edition, United States of America.
ii. Parker and Beth Brown, 2012, The Damn Good
iii. Leah M. Akins and Jefferson H. Akins, 2009, Technical Report Writing Guidelines, Dutchess Community College, Poughkeepsie, New York

Dean
Faculty of Pharmacy
M.S. Ramaiah University of Applied Sciences
Bangalore - 54.

Registrar
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054

Dean - Academics
M.S. Ramaiah University of Applied Sciences
Bangalore - 560 054