Dr. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, AURANGABAD

CIRCULAR NO.SU/Sci. & Tech./University Deptt./NEP/15/2023

It is hereby inform to all concerned that, the syllabi prepared by the Departmental Committee and recommended by the Dean, Faculty of Science & Technology, the Hon'ble Vice-Chancellor has accepted **the following curriculum of All Post Graduate Degree Courses as per Norms of National Education Policy – 2020 under the Faculty of Science & Technology run at University Department, Dr.Babasaheb Ambedkar Marathwada University, Aurangabad** in his emergency powers under section 12(7) of the Maharashtra Public Universities Act, 2016 on behalf of the Academic Council as appended herewith.

Sr.No.	Syllabi of Department of BAMU, Aurangabad.	Semester
1.	M.Sc.Chemistry specialization Inorganic Chemistry, Organic Chemistry, Physical Chemistry and self supported Analytical Chemistry	Ist and IInd Semester
2.	M.Sc.Statistics	Ist and IInd Semester
3.	M.Sc.Mathematics	Ist and IInd Semester
4.	M.Sc.Physics	Ist Semester
5.	M.Sc.Food Technology	Ist and IInd Semester
6.	M.Sc.Drug Intermediates Technology	Ist and IInd Semester
7	M.Sc. Information Technology	Ist to IVth Semester
8.	M.Sc.Computer Science	Ist to IVth Semester
9.	M.Sc.Botany	Ist and IInd Semester
10.	M.Sc.Enviornmental Science	Ist and IInd Semester
11.	M.Sc.Artificial Intelligence.	Ist to IVth Semester
12.	M.Sc.Biochemistry	Ist and IInd Semester

This is effective from the Academic Year 2023-24 and onwards.

All concerned are requested to note the contents of this circular and bring the notice to the students, teachers and staff for their information and necessary action.

University Campus,
Aurangabad-431 004.
REF.NO.SU/NEP/2023/ 8743-51
Date:- 08.08.2023.

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Deputy Registrar,
Academic Section

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2] **The Director, University Network & Information Centre, UNIC, with a request to upload this Circular on University Website.**

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DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, AURANGABAD

Department of Chemical Technology

Reaccredited with 'A' Grade

FACULTY OF SCIENCE & TECHNOLOGY

2 Years P.G. Programme in Science

(M.Sc.)

As per National Education Policy - 2020

(To be implemented from Academic Year - 2023-24)

Course Structure and Curriculum

(Outcome based Credit System)

Subject: Drug & Intermediate Technology

(Effective from 2023-24)

Dean
Faculty of Science & Technology
Dr. Babasaheb Ambedkar Marathwada
University, Aurangabad

Course Structure

Two-Year Post-graduate Program

Course and Credits Distribution of Two years Master's Degree Program with Entry & Exit option

Faculty of Science and Technology

Year / level	Sem.	Major subject		RM	OJT /FP	RP	Credits	Degree
		DSC Core Mandatory	DSE (Elective)					
First year 6.0	I	3(4) +2=14	4	4			22	PG Diploma (After 3 years degree)
	II	3(4) +2=14	4		4		22	
Cum. Cr. For PG Diploma		28	08	4	4		44	
Exit option with Post-graduate Diploma (44 credits) after first year or two semesters with completion of courses equivalent to 44 credits								
Second Year 6.5	III	3(4) +2=14	4			4	22	PG Degree after 3 years UG or PG Degree after 4 years UG
	IV	3 (4) = 12	4			6	22	
Cum. Cr. For 1 year PG Degree		26	8			10	44	
Cum. Cr. For 2 years PG Degree		54	16	4	4	10	88	
2 Years -4 sem.PG Degree (88 credits) after three-year UG Degree or 1 Year -2 sem. PG Degree (44 credits) after four year UG degree								

ABBREVIATION:

Major – Comprising Mandatory –is based on specialization

DSE- Discipline Specific Elective

OJT – On-the- Job Training

FP – Field Project (Corresponding to the Major (Core) Subject

RP – Research Project (Corresponding to the Major (Core) Subject

Internship/Apprenticeship - (Corresponding to the Major (Core) Subject

AS PER NEP 2020

Illustrative Credit distribution structure for Two Years Master's Degree Programme with Multiple Entry and Exit options –

Class: M. Sc. First Year Semester: I[st] Subject: Drug & Intermediate Technology

Course type	Course Code	Course Name	Teaching Scheme (Hrs./ week)		Credits Assigned		Total Credits
			Theory	Practical	Theory	Practical	
Major Mandatory DSC	MDT-111-T		2	-	2	-	14
	MDT-112-T		2	-	2	-	
	MDT-113-T		2	-	2	-	
	MDT-114-P		-	4	-	2	
	MDT-115-P		-	4	-	2	
	MDT-116-P		-	4	-	2	
	MDTSAT-11-P		-	4	-	2	
DSE (Choose **any one** from pool of courses)	MDT-117-T		2	-	2	-	04
	MDT-118-P		-	4	-	2	
	or						
	MDT-119-T		2	-	2	-	
	MDT-120-P		-	4	-	2	
RM	MDTRM-11-T		4	-	4	-	04
			12	**20**	**12**	**10**	**22 credits**

1. Major Mandatory (DSC-Discipline Specific Core)

MDT-111-T	Chemistry of Bioactive Heterocycles
MDT-112-T	Reaction Mechanism
MDT-113-T	Modern Drug Discovery
MDT-114-P	Lab-I: Chemistry of Bioactive Heterocycles
MDT-115-P	Lab-II: Reaction Mechanism
MDT-116-P	Lab-III: Modern Drug Discovery
MDTSAT-11-P	Lab-IV: Skill/Advance Technology

2. Discipline Specific Electives: (Choose any one from Pool /Basket)

MDT-117-T	Basic Unit Operations
MDT-118-P	Lab-I: Basic Unit Operations
or	
MDT-119-T	Industrial Chemistry
MDT-120-P	Lab-I: Industrial Chemistry

3. Research Methodology (RM): MDTRM-11-T

Class: M. Sc. First Year Semester: II[nd] Subject: Drug & Intermediate Technology

Course type	Course Code	Course Name	Teaching Scheme (Hrs./ week)		Credits Assigned		Total Credits
			Theory	Practical	Theory	Practical	
Major Mandatory DSC	MDT-121-T		2	-	2	-	14
	MDT-122-T		2	-	2	-	
	MDT-123-T		2	-	2	-	
	MDT-124-P		-	4	-	2	
	MDT-125-P		-	4	-	2	
	MDT-126-P		-	4	-	2	
	MDTSAT-12-P		-	4	-	2	
DSE (Choose **any one** from pool of courses)	MDT-127-T		2	-	2	-	04
	MDT-128-P		-	4	-	2	
	or						
	MDT-129-T		2	-	2	-	
	MDT-130-P		-	4	-	2	
OJT/FP	MDT/OJT/FP/12-P		-	~~8~~ 4	-	4	04
			08	~~28~~ 24	08	14	22 credits

1. Major Mandatory (DSC)

MDT-121-T	Advanced Organic Synthetic Chemistry
MDT-122-T	Bulk Drug and Fine Chemical Technology
MDT-123-T	Advanced Analytical Techniques
MDT-124-P	Lab-I: Advanced Organic Synthetic Chemistry
MDT-125-P	Lab-II: Bulk Drug and Fine Chemical Technology
MDT-126-P	Lab-III: Advanced Analytical Techniques
MDTSAT-12-P	Lab-IV: Skill/Advance Technology

2. Discipline Specific Electives: (Choose any one from Pool /Basket)

MDT-127-T	Stereochemical Applications
MDT-128-P	Lab-I: Stereochemical Applications
or	
MDT-129-T	Bio-organic and Bio-inorganic Chemistry
MDT-130-P	Lab-I: Bio-organic and Bio-inorganic Chemistry

3. OJT/FP-1: Field Project-I: MDT/OJT/FP/12-P

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad

UNIVERSITY DEPARTMENT OF CHEMICAL TECHNOLOGY

(Faculty of Science& Technology)

Syllabus of First Year M.Sc. (Drug and Intermediate Technology)

(Semester-I)

Subject Code No.: MDT-111 **Teaching Scheme:** **Theory:** 2 hrs/week **Credits: 02**	**Subject Title: Chemistry of Bioactive Heterocycles** **Theory Examination (Duration): 02 hours** **Theory Examination (Marks): 30** **Class Test: 20**

Course Objective: To study Heterocyclic compounds - Nomenclature, synthesis, reactivity, aromatic character, and medicinal importance of following heterocycles:

Unit	Course Content	Periods
I	Structure of heterocyclics; Introduction; Relationship of heterocyclic and carbocyclic aromatic compounds.; Systematic nomenclature. The relation between benzene ring and the heterocyclic rings Heterocycles with three members with one heteroatoms. 4-membered rings: Azetidines, Oxitanes and Thietanes	10hrs
II	Structure of Five-membered Rings with One Heteroatom; Reactivity of five-membered rings with one heteroatom; Electrophilic attack; Nucleophilic attack; Nucleophilic attack at nitrogen heteroatom; Nucleophilic attack at hydrogen attached to ring carbon or ring nitrogen.; Benzoderivatives of five-membered heterocycles with one heteroatom. Structure of five-membered rings with two or more heteroatoms; Azoles with heteroatoms in the 1,2-positions; Azoles with heteroatoms in the 1,3-positions; Reactivity of five-membered rings with two or more heteroatoms.	10hrs
III	Structure of six-membered rings with one heteroatom; Reactivity of six-membered rings with one heteroatom (Pyran, thiopyran,	10hrs

	Pyridine); Electrophilic attack; Nucleophilic attack; Nucleophilic attack at nitrogen heteroatom; Nucleophilic attack at hydrogen attached to ring carbon or ring nitrogen.; Benzoderivatives of six-membered heterocycles with one heteroatom. Heterocycles with Six-members with two or more heteroatoms. Structure and reactivity of 1,2- and 1,4- and 1,3 diazines ;triazines, tetrazines, oxadiazines and oxathiazines.	

Suggested Readings:

TEXT BOOKS

Sr. No.	Name of Book	Author
1	An introduction to chemistry of heterocyclic compounds (Interscience)	R. M. Acheson
2	Heterocyclic chemistry (Van Nossstrand)	Joule and Smith
3	Heterocyclic chemistry (Wiley E)	R.K. BANSAL
4	Principals of modern heterocyclic chemistry	L.A. Paquitte
5	The structure and reactions of heterocyclic compounds.	M.H. Palamer
6	Advances in Heterocyclic chemistry (A.P.)	A.R. Katrtzhy and A.V. Bootton
7	Organic chemistry (Vol. 1 and 2)	Finar
8	Outline of Biochemistry	Conn and Stumf
9	Introduction to the chemistry of enzyme action	Williams

REFERENCE BOOKS:

1. John A. Joule, Keith Mills.; Heterocyclic Chemistry, 5th Edition , April 2010, ©2010, Wiley-Blackwell, ISBN: 978-1-4051-3300-5, 718 pages
2. Gilchrist, T. L. Heterocyclic chemistry; 3rd ed.; Addison Wesley Longman: Edinburgh Gate, 1997.
3. Joule, J. A.; Mills, K.; Heterocyclic chemistry; 4th ed.; Blackwell Science: Oxford, 2000.

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UNIVERSITY DEPARTMENT OF CHEMICAL TECHNOLOGY
(Faculty of Science& Technology)
Syllabus of First Year M.Sc. (Drug and Intermediate Technology)
(Semester-I)

Subject Code No.: MTD- 112	**Subject Title: Reaction Mechanism**
Teaching Scheme:	**Theory Examination (Duration): 02 hours**
Theory: 2 hrs/week	**Theory Examination (Marks): 30**
Credits: 02	**Class Test: 20**

Course Objective: To study about the development and discovery of drugs, sources of drugs, different systems of medicine, dosage forms, toxicological evaluations, IPR.

Course Outcome:

Students will be able to,

1. Student should understand the various systems of medicines.
2. To understand concept of drug and different sources of drugs.
3. Student should able to learn lead discovery and pharmacophore identification.
4. To know about bioassays and toxicological evaluation of new drugs.
5. Student should understand the pre-clinical testing and clinical trials.
6. Student should able to understand the concept of Patents and intellectual property rights.
7. To know about Pharmacokinetics and Pharmacodynamics of drug action.

Student should able to understand the different dosage forms of drugs.

Unit	Course Content	Periods
I	Reaction Mechanism: Structure and Reactivity Types of Mechanisms, Types of reactions, Thermodynamic and Kinetic requirements, Kinetic and Thermodynamic control, Hammonds postulates, Curtin–Hammett principle, Potential energy diagrams, Transition states and intermediates, Methods of determining mechanisms, Isotope effects, Hard and soft acids and bases, Generation, structure, stability and reactivity of carbocations,	10hrs

	Carbanions, Free radicals, Carbenes and Nitrenes. Effect of structure on reactivity, Resonance and field effect, Steric effect, Quantitative treatment, The Hammett equation, Linear free energy relationship, Substituents and reaction constants, Taft equation. Pericyclic reactions analysis and their applications in synthesis, Recapitulation of Molecular Orbitals, their symmetry properties	
II	Woodward –Hoffmann's Conservation of orbital symmetry property rule. Application of Woodward –Hoffmann's Conservation of orbital symmetry property rule to the ground state and excited state Electrocyclic reactions, Cycloaddition reactions Chelotropic reactions, and Sigmatropic reactions Fukui's HOMO and LUMO orbitals Application of Fukui's HOMO and LUMO orbitals analysis to the ground state and excited state Electrocyclic reactions, Cycloaddition reactions, Chelotropic reactions and Sigmatropic reactions Synthesis of Endiandric acid (using pericyclic reactions)	10hrs
III	Photochemistry: Principles of photochemical reactions; orbital symmetry considerations, Excited states and their properties; experimental set up for photochemical reactions; Several useful photochemical reactions-olefin, carbonyl, aromatic phochemical reactions and their applications in organic synthesis (isomerization, Patterno-Buchi reaction, Barton reaction, Norrish type I and II reaction, Photoreduction, Rearrangements: di-π-methane, oxa di-π- and aza di-π-methane rearrangements, Photocycloaddition, Photochemical aromatic substitution reaction, Reactions with singlet oxygen. Applications of photochemical methods in synthesis: Isocumene, Cedrene, Hirsutene. Free radicals in organic synthesis Formation, stability and detection of long and short lived radicals, homolysis and free radical displacements, addition and rearrangement of free radicals, radical cyclizations and their applications in synthesis	10hrs

Suggested Readings:

References

1. Mechanism and structure in Organic Chemistry – E. S. Gould (Holt, Rinehart and Winston)
2. Advanced Organic Chemistry, Part A – F. A. Carey and R. J. Sundberg, 5th Ed. Springer (2007).
3. Radicals in Organic Synthesis B. Giese, Pergamon press (1986)
4. A) Organic photochemistry: A visual approach-Jan Kopecky, VCH publishers (1992).
   B) Excited states in Organic Chemistry- J.A. Barltrop and J.D.Coyle, John Wiley & sons
   C) Oganic Photochemistry-O. Kan
5. Conservation of orbital symmetry – R. B. Woodward and R. Hoffmann; Verlagchemie,weinheim (1970).
6. Orbital Symmetry : A problem solving approach- R. E. Lehr and A. P. Marchand; Academic (1972).
7. Organic reactions and orbital symmetry, 2nd Ed. T. L. Gilchrist and R. C. Storr; Cambridge University Press.
8. Classics in total synthesis- K. C. Nicolaou and E. J. Sorensen; VHC (1996)
9. P. A. Wender and J. J. Howbert J. Am. Chem. Soc. 103, 688-690 (1981) 10.Henning Hopf et al Eur. J. Org. Chem., 567-581, (2005) and references cited therein.
10. Mehta, G.; Reddy, A. V. J. Chem. Soc., Chem. Commun. 1981, 456-457. and references cited therein

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UNIVERSITY DEPARTMENT OF CHEMICAL TECHNOLOGY

(Faculty of Science& Technology)

Syllabus of First Year M.Sc. (Drug and Intermediate Technology)

(Semester-I)

Subject Code No.: MDT- 113	**Subject Title: Modern Drug Discovery**
Teaching Scheme:	**Theory Examination (Duration): 03 hours**
Theory: 2hrs/week	**Theory Examination (Marks): 30**
Credits: 02	**Class Test: 20**

Course Objective: To study about the development and discovery of drugs, sources of drugs, different systems of medicine, dosage forms, toxicological evaluations, IPR.

Course Outcome:

Students will be able to,

1. Student should understand the various systems of medicines.
2. To understand concept of drug and different sources of drugs.
3. Student should able to learn lead discovery and pharmacophore identification.
4. To know about bioassays and toxicological evaluation of new drugs.
5. Student should understand the pre-clinical testing and clinical trials.
6. Student should able to understand the concept of Patents and intellectual property rights.
7. To know about Pharmacokinetics and Pharmacodynamics of drug action.

Student should able to understand the different dosage forms of drugs.

Unit	Course Content	Periods
I	Discovery and Development of Drugs Introduction to drugs, History of drug discovery, Strategies in drug discovery, lead discovery, pharmacophore identification, lead development, Bioassays, screening of compounds. Drug targets- lipids, carbohydrates, proteins, and nucleic acids	10hrs
II	Sources of drugs: Microbial, Plant, Marine, synthetic, A historical perspective. Introduction to the different systems of medicines-Ayurveda, Allopathy, Unani and Homeopathy	10hrs

	Dosage forms:Routes of drug administration, formulation of Dosage forms, Types of dosage forms	
III	Toxicological evaluation of new drugs Pre-Clinical testing, Clinical trials, Bioavailabability of drugs, Bioequivalence Patents and intellectual property rights Pharmacokinetics and Pharmacodynamics of drug action From R & D to plant, QA, QC scale up process. GMP, FDA Documentation, Pharmacopeia, Industrial hygiene and safety	10hrs

Suggested Readings:

References

1. Medicinal Chemistry an Introduction-Gareth Thomas 2nd Ed. Wiley
2. An introduction to medicinal chemistry-Graham L. Patrick 5th Ed. Oxford
3. Introduction to Medicinal Chemistry-Alex Gringauz (Wiley)
4. Comprehensive Medicinal Chemistry Vol-I (Hansch (1990) Pergamon press
5. Principle of Drug action-Goldstein.
6. Bioavailabinty and Bio equivalence-H.P.Tinis.
7. Pharmacoepia of India, British pharmecoepia, US Pharmacoepia
8. Pharmaceutical Dosage forms and Drug Delivery system VIthEdn. .Arnel (Wessl
9. Organic Chemistry of Drug Design and Drug Action. R.B.Silverman (1993) Academic Press

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Syllabus of First Year M.Sc. (Drug and Intermediate Technology Course.)

(Semester-I)

Subject Code No.: MDT-114 **Teaching Scheme:** **Practicals: 4 hrs/week** **Credits: 02**	**Subject Title: Lab I-Chemistry of Bioactive Heterocycles** **Examination (Duration): 06 hours** **Examination (Marks): 30** **Internal: 20**

Sr. No.	List of Practicals
I	**Techniques:** Crystallization, fractional crystallization, fractional distillation, sublimation, steam distillation, column chromatography, thin layer chromatography, GC, HPLC. Derivatives of functional groups such as acetyl, 2,4-DNP, anilide, amide and aryloxy acetic acid
II	**Single stage preparations** (minimum 6 preparations) Synthesis of pain relieving drugs Asprin, benzocaine, phenacetin, acetoaminophenone, methyl salicylate, ibuprophen **Three stage preparations** (minimum one preparation) 1. alpha naphthol→ o-alkylation with epichlorohydrin→epoxide opening with amine→N- alkylation 2. Pthalic acid →pthalic anhydride →phthalimide→anthranilic acid
III	**Two stage preparations** (minimum 4 preparations) Benzoin →Benzil→Benzilic acid ↓Quinoxaline Substituted aniline → acetanilide →Bromination Substituted aniline → acetanilide-→ nitration Phthalic anhydride → o-benzoyl benzoic acid →anthraquinoneAcetophenone→benzalacetophenone→ epoxide Hydroquinone →quinone→ 1,2,4-triacetoxybenzene

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Syllabus of First Year M.Sc. (Drug and Intermediate Technology Course.)

(Semester-I)

Subject Code No.: MDT-115 **Teaching Scheme:** **Practicals: 4 hrs/week** **Credits: 02**	**Subject Title: Lab I-Reaction Mechanism** **Examination (Duration): 06 hours** **Examination (Marks): 30** **Internal: 20**

Sr. No.	List of Practicals
I	Solvent Free Carbon–Carbon Bond Formation : Pinacol coupling reaction, Dieckmann condensation, Knoevenagel condensation, 3-carboxycoumarin, Pechmann reaction Solvent-Free C–N Bond Formation:terephthalic acid dihydrazide, azomethine synthesis
II	Solvent-Free C–S Bond Formation:1,3-dithiolane synthesis Solvent-Free C–X Bond Formation:Cinnamic acid/ stilbene halogenations, Phenol bromination using N-bromosuccinimide Solvent-Free N–N Bond Formation: Triazenes Synthesis, Beckmann rearrangement
III	Other Solvent-Free Reactions 1. D-mannitol protection using phenylboronic acid 2. Baeyer-Villiger reaction 3. 2-Hydroxybenzaldehyde oxidation using urea-hydrogen peroxideComplex 4. Alumina-supported permanganate oxidation Solvent free supramolecular assembly formation 1. Caffeine and oxalic acid 2. rac-Bis-beta-naphthol and benzoquinone

Reference: Solvent-free Organic Synthesis by Koichi Tanaka (Copyright © 2009 WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim, ISBN: 978-3-527-32264-)

Additional Study Material: https://nptel.ac.in/courses/104/106/104106108/

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Syllabus of First Year M.Sc. (Drug and Intermediate Technology)

(Semester-I)

Subject Code No.: MDT-116 **Teaching Scheme:** **Practicals: 4 hrs/week** **Credits: 02**	**Subject Title: Lab I- Modern Drug Discovery** **Examination (Duration): 06 hours** **Examination (Marks): 30** **Internal: 20**

Sr. No.	List of Practicals
I	In-silico QSAR studies.
II	In-silico docking studies.
III	In-silico pharmacophore based screening.
IV	ADMET Studies
V	MDS Studies
Vi	Water –MAP studies
VII	DFT Calculation studies
VIII	Target Identification and Validation studies
IX	High Throughput Screening studies
X	To study the lead optimization
XI	To study the novelty with different online tools.

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UNIVERSITY DEPARTMENT OF CHEMICAL TECHNOLOGY
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Syllabus of First Year M.Sc. (Drug and Intermediate Technology.)
(Semester-I)

Subject Code No.: MDT-117	**Subject Title: Basic Unit operations**
Teaching Scheme: 2 credits	**Theory Examination (Duration): 2 h**
Theory: 2 hrs/week	**Theory Examination (Marks): 30**
Credits: 02	**Class Test: 20**

Course Objective:

To apply principles of basic unit operations.

To apply principles of heat transfer.

To apply principles of mass transfer

Course Outcome:

The student will be able to classify various unit operations

The student will be able to select a characterization method for a powdered sample

The student will be able to calculate power required by size reduction equipment using laws of size reduction

NBA Attributes

Engineering knowledge

Problem analysis

Design and development of solutions

Unit	Course Content	Periods
I	Concept of Unit Operation, Classification of unit operations, application of unit operations in pharmaceutical industry Particle and its characterization, Concept of Feret's diameter, Martin's diameter and sphericity. Classification, Type of screen, Sieve shaker, Grizzly,	10

	Trommel, bar screen and vibrating screen, Screen analysis, Differential and cumulative screen analysis, Numerical on screen analysis	
II	Size reduction, laws of crushing and grinding, kick's law, Rittinger's law, Bond's law,, Equipments for size reduction working on the principle of impact, compression, attrition and shearing, Numerical on size reduction. Properties of solids, Storage of solids, Bin, Silo, Flow through hoppers, Handling of solids, Conveying of solids, Concept of pneumatic conveying, Problems associated with handling of solids	10
III	Introduction to heat transfer, modes of heat transfer, Evaporator and boiler, Heat transfer equipment in pharmaceutical industry. Introduction to mass transfer, classification of mass transfer operations,, industrial applications of distillation, drying, extraction, mass transfer equipment in pharmaceutical industry	10

Suggested Readings:

TEXT BOOKS

Sr. No.	Name of Book	Author	Publisher
1.	Chemical Engineering, Volume: 1 & 2	J.M Coulson and J.F Richardson	Butterworth Heinmann limited 2001-2002
2	Unit operations of chemical engineering	W.L.Mc Cabe, J.C. Smith and P. Harriott	Mc Graw Hill
3	Transport processes and unit operations	Christie J. Geankoplis	Printice Hall of India
4	Mechanical Operations Vol 1	R.S Hiremath and A.P. Kulkarni	Everest Publishing House
5	Mechanical Operations	Anup swain , Hemlata Patra, G.K.Roy	Tata McGraw Hill

REFERENCE BOOKS

Sr. No.	Name of Book	Author	Publisher
1	Introduction to chemical engineering	S. K. Ghosal, S. K. Sanyal and S. Dutta	TMH publications, 1993
2	Chemical engineer's handbook by Perry	-	Mc Graw Hill publications

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UNIVERSITY DEPARTMENT OF CHEMICAL TECHNOLOGY
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Syllabus of First Year M.sc. (Drug and Intermediate Technology)
(Semester-I)

Subject Code No.: MDT-118 **Teaching Scheme:** **Theory:** 4hrs/week **Credits:** 02	**Subject title:** Lab-I Basic Unit Operations **Examination duration:** 06 hrs **Examination (Marks):** 30 Internal: 20

Sr. No.	List of Practical's	
1.	1	To calculate critical speed of ball mill
	2	To observe the effect of critical speed on grinding
	3	To perform crushing using a jaw crusher
	4	To perform grinding using a ball mill
	5	To carry out batch sedimentation
2.	6	To measure settleable solids
	7	To observe effect of viscosity on sedimentation
	8	To design a settling unit
	9	To Carry out screen analysis-I
	10	To Carry out screen analysis-II
3.	11	To calculate angle of repose
	12	To study a bar type magnetic separator
	13	To study the electrostatic precipitator
	14	To study wet grinding
	15	To study flow patterns during mixing process

Suggested Readings

Reference/Text books/manuals

Sr. No.	Name of Book	Author	Publisher
1	Mechanical Operations Vol 1	R.S Hiremath and A.P. Kulkarni	Everest Publishing House
2	UDCT Mechanical operations manual	-	-

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(Faculty of Science& Technology)

Syllabus of First Year M.Sc. (Drug and Intermediate Technology)

(Semester-I)

Subject Code No.: MTD-119	**Subject Title: Industrial Chemistry**
Teaching Scheme:	**Theory Examination (Duration): 02 hours**
Theory: 2 hrs/week	**Theory Examination (Marks): 30**
Credits: 02	**Class Test: 20**

Course Objective: To study the process development in industry by evaluating material balance, energy balance problems along with equipment designing, brief study of different unit operations in industry.

Course Outcome:

Students will be able to,

1. Student should understand the chemistry involved in process development in industry.
2. To understand concept of Material balance and energy balance equations.
3. Student should able to design equipment and vessel ceramics.
4. To know about various unit operations involved in industrial applications.
5. Student should understand the concept of industrial instrumentation.
6. Student should able to understand the concept of Industrial waste management and treatment of waste.

Unit	Course Content	Periods
I	Material balance: Process classification, Choice of system and basis of molecular processes with chemical reactions, Material balance calculations, Multiple unit processes, Recycle and bypass. Energy balance: Forms of energy, Energy balance, Energy changes in physical processes, Energy changes in reactions, Energy balance Calculations. Equipment Design: Material of constructions: Mechanical properties, Corrosion resistance, Plastics.	10hrs

	Ceramics: Metals and alloys, Stainless steel, Special material for food and pharmaceutical equipment, Protective coatings, Surface treatment to metals for corrosion resistance.	
III	Distillation: Boiling and distillation, vapor-liquid equilibria, Rault's law & Henry's law,flash distillation, steam distillation, vacuum distillation, fractional distillation, Extractions: Liquid equilibria, Extraction with reflux, Extraction with agitation, equipment, it's use and performance, flow sheets of solid-liquid extraction, continuous leaching, counter current extraction. Filtration: Classification of filters, Sand filters, filter press, plates & frame press, filter aids, principles of leaf filters. Crystallization: Growth of Crystal, saturation, nucleation supersaturation, continuous vaccum crystallizers. Drying: General Principles (Significance, moisture content), Drying equipments, Tray dryers, Rotary dryers, Single Drum dryer & Spray dryers.	10hrs
III	Industrial Instrumentation: Measurement of temperature, Thermo couples and pyrometers, High temperature thermometers, Optical pyrometers, Measurement of pressure and vacuum, Manometric and Bourdon gauges, Vacuum gauges, Ionization and pirani gauges. Industrial Waste Management: Definition, Classification, sources and composition of solid, liquid and gaseous wastes, hazardous and non-hazardous wastes, special waste materials, Storage and transport of wastes, Transportation and collection systems, Management of wastes, minimization, reuse and recycling, waste utilization and materials recovery. Treatment of wastes: biological treatment, composting, anaerobic digestion, combustion, incineration and landfills, ultimate disposal.	10hrs

Suggested Readings:

References

1. F. A. Henglein: Chemical Technology (Pergamon).
2. J. M. Coulson, J. F. Richardson: Chemical Engineering, Vol. I, II, III (Pergamon).
3. R.N. Shrove: The Chemical Process Industries (MGH).
4. W.L. Badger and J.T. Bandchero: Introduction to Chemical Engineering (MGH).
5. O.A. Hougen, K.M. Watson and R.A. Ragetz: Chemical Process Principles, Vol. I, II (JW).
6. P.H. Groggins: Unit Processes in Organic Synthesis (MGH)
7. G.H. Morrison & H. Freiser: Solvent extraction in Analytical Chemistry (John Wiley)
8. K.A. Gavhane: Unit operations II (NiraliPrakashan, Pune)

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Syllabus of First Year M.Sc. (Drug and Intermediate Technology Course.)

(Semester-I)

Subject Code No.: MDT-120 **Teaching Scheme:** **Practicals: 4 hrs/week** **Credits: 02**	**Subject Title: Lab I-Industrial Chemistry** **Examination (Duration): 06 hours** **Examination (Marks): 30** **Internal: 20**

Sr. No.	List of Practicals
I	1. Preparation of standard solution of $K_2Cr_2O_7$. To find out the concentration of unknown $K_2Cr_2O_7$ solution using $Na_2S_2O_3$ solution as an intermediate. 2. Preparation of standard solution of copper sulphate. To find out the concentration of unknown copper sulphate solution using $Na_2S_2O_3$ solution as an intermediate. 3. Preparation of standardKMnO4 and ferrous ammonium sulphate solution. To find out the strength of unknown ferrous ammonium sulphate solution using as an intermediate. 4. Viscosity of liquids: Determination of relative viscosity of a liquid with water. Determination of % composition of an unknown solution.
II	5. Surface Tension of liquids: Determination of the surface tension of an organic liquid. Determination of % composition of an unknown mixture. 6. Polari-meter: Determination of the specific rotation of sucrose solution. 7. Refractometer: Determination of Refractive Index of a liquid by Abbe's refractometer. Determination of Molar refractivity and specific refractivity of a liquid by using Abbe's refractometer. 8. To find out the melting points of organic compounds.
III	9. To find out the boiling points of organic compounds. 10. To find out the partition coefficient of –Iodine between CCl4 and water Acetic acid between water and benzene.

	11. Chromatography: To separate and identify the amino acids by ascending paper chromatography. To separate and identify the sugars by ascending paper chromatography. 12. Separation of a mixture of dyes by column chromatography. 13. Preparation of Aspirin.

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(Semester-II)

Subject Code No.: MDTRM-11-T **Teaching Scheme:** **Theory:** 4hrs/week **Credits:** 04	**Subject title:** Research Methodology **Theory Examination duration:** 03 hrs **Theory Examination (Marks):** 80 **Class Test:** 20

Course Objectives: To develop a research orientation among the scholars and to acquaint them with fundamentals of research methods Specifically, the course aims at introducing them to the basic concepts used in research and to scientific social research methods and their approach. It includes discussions on sampling techniques, research designs and techniques of analysis.

Course Outcomes:

1. To develop understanding of the basic framework of research process
2. To develop an understanding of various research designs and techniques
3. To identify various sources of information for literature review and data collection
4. Understand some basic concepts of research and its methodologies
5. Organize and conduct research in a more appropriate manner
6. Write a research report and thesis
7. Write a research proposal

Unit	Course Content	Periods
1.	**Research** Meaning, objective of research, types of research Selecting a problem and preparing research proposal for different types of research **Literature survey** -Use of library, books and journals, use of internet (different useful sites), patent search Methods and tools in research Qualitative and quantitative studies, Inquiry forms, Questionnaire, Opinionnaire	20hrs
2.	**Data analysis** Parametric and non-parametric data, Hypothesis testing, Descriptive and Inferential analysis, Statistical analysis of data including standard deviation, student "t" test, "f" test, ANOVA, Multiple regression and correlation coefficient **Research paper/Thesis writing** Different parts of the research paper. Presentation: Oral, poster	20hrs

3.	**Sources of procurement of research grants** Industrial Institution Interaction **Introduction to IPR** Patents, its Legislation, Types, Patentability, various components of a patent, general process of patent in India, Introduction to PTC and USPTO	20hrs

Recommended Books

1. Research In Education by John V. Best, John V. Kahn 2. Presentation skills by Michael Hallon
3. Practical Introduction to copyright by Gavin Mcfarlane
4. Thesis projects in Science & Engineering by Richard M. Davis. 5. Scientist in legal Systems by Ann labor science
6. Thesis & Assignment by Jonathan Anderson
7. Writing a technical paper by Donald Menzel 8. Effective Business Report Writing byLeland Brown
9. Protection of industrial Property rights by P. Das & Gokul Das
10. Spelling for the millions by Edna Furmess 11. Preparation for publication by King Edward Hospital Fund for London
12. The Patent Act, 1970 along with The Patent Rules, 2003

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(Semester-II)

Subject Code No.: MDT-121 **Teaching Scheme:** **Theory:** 2hrs/week **Credits:** 02	**Subject title:** Advanced Organic Synthetic Chemistry **Theory Examination duration:** 02 hrs **Theory Examination (Marks):** 30 **Class Test:** 20

Course Objectives: The subject is designed to provide in-depth knowledge about advances in organic chemistry, different techniques of organic synthesis and their applications to process chemistry as well as drug discovery.

Course Outcomes:

1. Upon completion of course, the student shall be to understand
2. The principles and applications of retro synthesis
3. The mechanism & applications of various named reactions
4. The concept of disconnection to develop synthetic routes for small target molecule
5. The various catalysts used in organic reactions
6. The chemistry of heterocyclic compounds

Unit	Course Content	Periods
1.	**Basic Aspects of Organic Chemistry** 1. Organic intermediates: Carbocations, carbanions, free radicals, carbenes and nitrenes. Their method of formation, stability and synthetic applications. 2. Types of reaction mechanisms and methods of determining them, 3. Detailed knowledge regarding the reactions, mechanisms and their relative reactivity and orientations. **Addition reactions** a) Nucleophilic uni- and bimolecular reactions (SN1 and SN2) b) Elimination reactions (E1 & E2; Hoffman & Saytzeff's rule) c) Rearrangement reaction **Study of mechanism and synthetic applications of following named 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	10hrs
2.	**Synthetic Reagents & Applications** Aluminiumisopropoxide, N-bromosuccinamide, diazomethane, dicyclohexylcarbodimide, Wilkinson reagent, Witting reagent. Osmium tetroxide, titanium chloride, diazopropane, diethyl	10hrs

	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	
3.	**Heterocyclic Chemistry** Organic Name reactions with their respective mechanism and application involved in synthesis of drugs containing five, six membered and fused hetrocyclics 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 hetrocyclic 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. **Synthon approach and retrosynthesis applications** i. Basic principles, terminologies and advantages of retrosynthesis; guidelines for dissection of molecules. Functional group interconvertion and addition (FGI and FGA) 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.	10hrs

REFERENCES

1. "Advanced Organic chemistry, Reaction, Mechanisms and Structure", J March, John Wiley and Sons, New York.
2. "Mechanism and Structure in Organic Chemistry", ES Gould, Hold Rinchart and Winston, New York.
3. "Organic Chemistry" Clayden, Greeves, Warren and Woihers., Oxford University Press 2001.
4. "Organic Chemistry" Vol-I and II. I.L. Finar. ELBS, Pearson Education Lts, Dorling Kindersley 9India) Pvt. Ltd.,.
5. A guide to mechanisms in Organic Chemistry, Peter Skyes (Orient Longman, New Delhi).
6. Reactive Intermediates in Organic Chemistry, Tandom and Gowel, Oxford & IBH Publishers.
7. Combinational Chemistry- Synthesis and applications- Stephen R Wilson & Anthony W Czarnik, Wiley-Blackwell.
8. Carey, Organic Chemistry, 5th Edition (Viva Books Pvt. Ltd.)
9. Organic Synthesis -The Disconnection Approach, S. Warren, Wily India
10. Principles of Organic Synthesis, ROC Norman and JM Coxan, Nelson Thorns.
11. Organic Synthesis-Special Techniques. VK Ahluwalia and R Agarwal, Narosa Publishers.
12. Organic Reaction Mechanisms IVth Edtn, VK Ahluwalia and RK Parashar, Narosa Publishers.

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(Semester-II)

Subject Code No.: MDT-122 **Teaching Scheme:** **Theory:** 2hrs/week **Credits:** 02	**Subject title:** Bulk Drug and Fine Chemical Technology **Theory Examination duration:** 02 hrs **Theory Examination (Marks):** 30 **Class Test:** 20

Course Objectives: To Study of Chemical technology of selected Fine chemicals and Speciality chemicals. To study about the plant design, production techniques and process chemistry involved in the bulk drug industry.

Course Outcomes:

1. Grasp the manufacturing of various Fine chemicals and speciality chemicals
2. Understand the process flow diagram and various process parameters
3. Identify and solve engineering problems during production The mechanism & applications of various named reactions
4. Apply the knowledge of the production techniques of bulk drugs.
5. Acquire the knowledge on plant design, process development and chemical hazards in bulk drug industry.
6. Understand kinetics, thermodynamics and plant construction materials for the production of bulk drugs.

Unit	Course Content	Periods
1.	**Introduction:** Importance of Development of Bulk Drug Technology, Import, Export of Bulk drugs, Development of Process chemistry, Characteristic features of fine and speciality chemicals manufacture. Types of Catalysts in Fine Chemicals Synthesis. **Chemistry of Fine and Speciality Chemicals Synthesis:** Historical development of organic synthesis. Fine and speciality chemicals vs. bulk chemicals manufacture. Process selection: process profile analysis. **Aspects of Process Development of Fine and speciality Chemicals:** Steps in process development. Scale-up procedures. Chemical reactor scale-up, design, and operation.	10hrs
2.	**Manufacturing Facilities of Fine and speciality Chemicals:** Types of production plants. Typical equipment in a multi-product plant. Production costs. Design and scheduling of batch plants. GLP: Good Laboratory and Manufacturing Practices: Quality Assurance and Regulatory Affairs **Process Development and Hazards:** Developing the best synthetic route, Selection of the best route for scale-up, Choice of raw materials and reagents based on availability, cost, hazard, recovery possibilities, recyclability. Development techniques for safe process design. Few examples as case studies.	10hrs

3.	**Production, Planning and Control:** Flow sheets, Types of flow sheets, Flow symbols, Line symbols, Concept of all purpose and multipurpose plants, Plant design, Layout, Process economics, Materials of construction, Effluent treatment, and solvent recovery for bulk drugs. **Bulk Drugs Production:** Raw Materials, Production Techniques, Reaction Flow Sheet, Equipments, Utilities for the production of drugs below Paracetamol, Aspirin, Ibuprofen, Diazepam, Vitamin C, Salbutamol, Ranitidine.	10hrs

REFERENCES

1. Fine Chemicals Manufacture: Technology and Engineering by A. Cybulski M.M. Sharma R.A. Sheldon J.A. Moulijn
2. A Text Book of Chemical Technology by Pandey, G.N.
3. Chemical Process Industries by Austin, G.T., Shreves
4. Specialty Chemicals Innovations in industrial synthesis and applications by B Perason
5. Practical Process Research and Development by Neal G. Anderson

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(Semester-II)

Subject Code No.: MDT-123 **Teaching Scheme:** **Theory:** 2hrs/week **Credits:** 02	**Subject title:** Advanced Analytical Techniques **Theory Examination duration:** 02 hrs **Theory Examination (Marks):** 30 **Class Test:** 20

Course Objectives: This subject deals with various advanced analytical instrumental techniques for identification, characterization and quantification of drugs. Instruments dealt are NMR, Mass spectrometer, IR, HPLC, GC etc.

Course Outcomes:

After completion of course student is able to know about chemicals and excipients.

1. The analysis of various drugs in single and combination dosage forms
2. Theoretical and practical skills of the instruments

Unit	Course Content	Periods
1.	**UV-Visible spectroscopy:** Introduction, Theory, Laws, Instrumentation associated with UV-Visible spectroscopy, Choice of solvents and solvent effect and Applications of UV-Visible spectroscopy, Difference/ Derivative spectroscopy. **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. **Spectroflourimetry:** Theory of Fluorescence, Factors affecting fluorescence (Characterestics of drugs that can be analysed by flourimetry), Quenchers, Instrumentation and Applications of fluorescence spectrophotometer. **Flame emission spectroscopy and Atomic absorption spectroscopy:** Principle, Instrumentation, Interferences and Applications.	10hrs
2.	**NMR spectroscopy:** Quantum numbers and their role in NMR, Principle, Instrumentation, Solvent requirement in NMR, Relaxation process, NMR signals in various compounds, Chemical shift, Factors influencing chemical shift, Spin-Spin coupling, Coupling constant, Nuclear magnetic double resonance, Brief outline of principles of FT-NMR and 13C NMR. Applications of NMR spectroscopy. **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.	10hrs
3.	**Chromatography:** Principle, apparatus, instrumentation, chromatographic parameters, factors affecting resolution, isolation of drug from excipients, data interpretation and applications of the following:	10hrs

	a) Thin Layer chromatography b) 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 **Electrophoresis, X ray Crystallography, Potentiometry, Thermal Techniques, Differential Thermal Analysis (DTA):** Principal & Working.	

REFERENCES

1. Spectrometric Identification of Organic compounds - Robert M Silverstein, Sixth edition, John Wiley & Sons, 2004.
2. Principles of Instrumental Analysis - Doglas A Skoog, F. James Holler, Timothy A. Nieman, 5th edition, Eastern press, Bangalore, 1998.
3. Instrumental methods of analysis – Willards, 7th edition, CBS publishers.
4. Practical Pharmaceutical Chemistry – Beckett and Stenlake, Vol II, 4th edition, CBS Publishers, New Delhi, 1997.
5. Organic Spectroscopy - William Kemp, 3rd edition, ELBS, 1991.
6. Quantitative Analysis of Drugs in Pharmaceutical formulation - P D Sethi, 3rd Edition, CBS Publishers, New Delhi, 1997.
7. Pharmaceutical Analysis - Modern Methods – Part B - J W Munson, Vol 11, Marcel. Dekker Series
8. Spectroscopy of Organic Compounds, 2nd edn., P.S/Kalsi, Wiley estern Ltd., Delhi.
9. Textbook of Pharmaceutical Analysis, KA.Connors, 3rd Edition, John Wiley & Sons, 1982.

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(Semester-II)

Subject Code No.: MDT-124 **Teaching Scheme:** **Theory:** 4hrs/week **Credits:** 02	**Subject title:** Lab-I Advanced Organic Synthetic Chemistry **Examination duration:** 06 hrs **Examination (Marks):** 30 Internal: 20

Sr. No.	List of Practical's
1.	Analysis of Pharmacopoeial compounds and their formulations by UV Vis spectrophotometer, Simultaneous estimation of multi component containing formulations by UV spectrophotometry, Experiments based on Column chromatography,
2.	To perform the following reactions of synthetic importance Purification of organic solvents, column chromatography, Claisen-schimidt reaction, Benzillic acid rearrangement, Beckmann rearrangement, Hoffmann rearrangement, Mannich reaction Fischer indole synthesis
3.	Synthesis of medicinally important compounds involving more than one-step along with purification and Characterization using TLC, melting point and IR spectroscopy, Estimation of elements and functional groups in organic compounds. 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.

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(Semester-II)

Subject Code No.: MDT-125 **Teaching Scheme:** **Practicals: 4 hrs/week** **Credits: 02**	**Subject Title: Lab II-Bulk Drug & Fine Chemical Technology** **Examination (Duration): 06 hours** **Examination (Marks): 30** **Internal: 20**

Sr. No.	List of Practicals
I	1. To perform synthesis of Aspirin and Recrystallize it. 2. To perform synthesis of 7-Hydroxy-4-methyl coumarin and Recrystallize it. 3. To perform synthesis of p-acetamido benzene sulphonyl chloride. 4. To perform synthesis of p-acetamido benzene sulphonamide.
II	5. To perform synthesis of p-amino benzene sulphonamide and Recrystallize it. 6. To perform synthesis of fluorescein by condensing phthalic anhydride and report yield. 7. To perform synthesis of Eosin from the crude product fluorscein.
III	8. To perform synthesis of Benzoyl chloride from Benzoic acid. 9. To perform synthesis of Triphenyl imidazole from Benzyl and Benzaldehyde. 10. To study the Hydrogenation using heterogenous catalysts.

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(Semester-II)

Subject Code No.: MDT-126 **Teaching Scheme:** **Practicals: 4 hrs/week** **Credits: 02**	**Subject Title: Lab III-Advanced Analytical Techniques** **Examination (Duration): 06 hours** **Examination (Marks): 30** **Internal: 20**

Sr. No.	List of Practicals
I	1. Analysis of Pharmacopoeial compounds and their formulations by UV Vis spectrophotometer 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
II	7. Assay of official compounds by different titrations 8. Assay of official compounds by instrumental techniques. 9. Quantitative determination of hydroxyl group. 10. Quantitative determination of amino group 11. Colorimetric determination of drugs by using different reagents 12. Imupurity profiling of drugs 13. Calibration of glassware's
III	14. Calibration of pH meter 15. Calibration of UV-Visible spectrophotometer 16. Calibration of FTIR spectrophotometer 17. Calibration of GC instrument 18. Calibration of HPLC instrument 19. Cleaning validation of any one equipment

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(Semester-II)

Subject Code No.: MDT-127 **Teaching Scheme:** **Theory:** 2hrs/week **Credits:** 02	**Subject title:** Stereochemical Applications **Theory Examination duration:** 02 hrs **Theory Examination (Marks):** 30 **Class Test:** 20

Course Objectives:
The subject is designed to provide in-depth knowledge about stereochemistry, and their applications to chemistry as well as drug discovery.

Course Outcomes:
1. Learn the concept stereochemistry and its importance; their rules
2. To understand stereochemistry of heterocyclic compound containing six and five rings with their structure, synthesis and reactions.
3. To know stereochemistry of organic compounds; able to assign R and S to given molecules; understand stereoselective and stereospecific reactions; acquire knowledge on topicity.
4. To understand concepts of Racemization and Resolution methods
5. To understand stereochemistry of drug molecules

Unit	Course Content	Periods
1.	**Concepts of Stereochemistry** **Stereochemistry of six and five membered rings** Relation to physical properties, conformation and chemical reactivity, conformational effects in six and five membered rings containing unsaturation **Conformational concepts:** Conformations of acyclic molecules, cyclohexane and mono- and di-substituted cyclohexane, Conformational effect on physical properties of the molecules	10hrs
2.	**Stereochemistry of drug molecules** Saquinavir (HIV protease inhibitor), Abiraterone (drug for prostate cancer), ephedrine and pseudoephedrine, *R*- and *S-enantiomer* of Ibuprofen (non-steroidal anti-inflammatory) *R*- and *S-enantiomers* of thalidomide	10hrs
3.	**Principles and applications of asymmetric synthesis** Stereoselectivity in cyclic compounds, enantio-selectivity, diastereo-selectivity, enantiomeric and diastereomeric excess, Stereoselective aldol reactions, Cram's rule, FelkinAnh rule, Cram's chelate modcl, asymmetric synthesis, use of chiral auxiliaries, chiral reagents and catalysis, asymmetric hydrogenation, asymmetric epoxidation and asymmetricdihydroxylation. Synthetic and industrial applications. **Racemization and Resolution methods**	10hrs

	Stereochemistry if a polymer chain -Types and examples of tacticity	

REFERENCES

1. Stereochemistry of carbon compound- by E.L. Eliel
2. Stereochemistry of organic compound- byNasipuri
3. Stereochemistry of carbon compound- byE.L. Eliel and S.H. Wilen
4. Organic Chemistry- by J. Clayden
5. Topics in Stereochemistry (Volume 2)– by Norman L. Allinger and Ernest L. Eliel
6. Stereochemistry of carbon compound- by P.S. Kalsi
7. Organic Stereochemistry- by Jagdamba Singh

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(Semester-I)

Subject Code No.: MDT-128 **Teaching Scheme:** **Practicals: 4 hrs/week** **Credits: 02**	**Subject Title: Lab I- Stereochemical Applications** **Examination (Duration): 06 hours** **Examination (Marks): 30** **Internal: 20**

Sr. No.	List of Practicals
I	i. Acetylation of one of the following compounds: amines (aniline, o-, m-, ptoluidines and o-, m-, p-anisidine) and phenols (β-naphthol, vanillin, salicylic acid) by any one method: a. Using conventional method. b. Using green approach ii. Benzolyation of one of the following amines (aniline, o-, m-, p- toluidines and o, m-, p-anisidine) and one of the following phenols (β-naphthol, resorcinol, pcresol) by Schotten-Baumann reaction. iii. Oxidation of ethanol/ isopropanol (Iodoform reaction).
II	iv. Bromination of any one of the following: a. Acetanilide by conventional methods b. Acetanilide using green approach (Bromate-bromide method) v. Nitration of any one of the following: a. Acetanilide/nitrobenzene by conventional method b. Salicylic acid by green approach (using ceric ammonium nitrate). vi. Selective reduction of meta dinitrobenzene to m-nitroaniline. vii. Reduction of p-nitrobenzaldehydc by sodium borohydride.
III	viii. Hydrolysis of amides and esters. ix. Semicarbazone of any one of the following compounds: acetone, ethyl methyl ketone, cyclohexanone, benzaldehyde.

	x. S-Benzylisothiouronium salt of one each of water soluble and water insoluble acids (benzoic acid, oxalic acid, phenyl acetic acid and phthalic acid). xi. Aldol condensation using either conventional or green method. xii. Benzil-Benzilic acid rearrangement.

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(Semester-II)

Subject Code No.: MDT-129 **Teaching Scheme:** **Theory:** 2hrs/week **Credits:** 02	**Subject title:** Bioorganic and Bioinorganic Chemistry **Theory Examination duration:** 02 hrs **Theory Examination (Marks):** 30 **Class Test:** 20

Course Objectives:
The more advanced chemical and biochemical aspects and methods are all developed during the course. The course will provide students with a general overview of the many very fundamental tasks performed by inorganic elements in living organisms as well as the related methods and theories with particular emphasis on enzymatic conversions and electron transfer. This goes along with the elucidation of model systems and technical applications of both, concepts learned from nature as well as biological systems.

Course Outcomes:
1. Understand how metal ions interact with biological environments and how these interaction influences the properties of metal centers.
2. Apply principles of coordination chemistry to explain how nature tailors properties of metal centers for specific applications.
3. Know the nature, function of different bio-minerals, and understand the mechanism of biomineralization based on principles.
4. Understand applications of nanoparticels in biology, functions of non-redox active elements for protein.
5. Know and understand medical applications of metal ions and complexes.

Unit	Course Content	Periods
1.	**Introduction:** Bioinorganic Chemistry, **Biomolecules:** (carbohydrates, lipids, proteins, and nucleic acids), Common Chemical Mechanisms Basic biological Coordination Chemistry, Kinetic and spectroscopic characteristics of bioinorganic systems	10hrs
2.	**Non-redox active metals**, Ion transport: membranes, energy, channels, pumps **Biomineralization**, Nanoparticles, Inorganic structural elements in proteins, RNA & DNA Lewis acid catalysis	10hrs

3.	**Transition metals,** Metals in medicine: anti cancer agents, diabetes, arthritis, radionuclides and related applications Biological conversion and formation of hydrogen and nitrogen– hydrogenases and nitrogenases	10hrs

Recommended Books

1. Ivano Bertini, Harry B. Gray, Edward I. Stiefel, Joan Selverstone Valentine, Biological Inorganic Chemistry – Structure & Reactivity
2. John E. McMurry and Tadhg P. Begley

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(Semester-II)

Subject Code No.: MDT-130 **Teaching Scheme:** **Practicals: 4 hrs/week** **Credits: 02**	**Subject Title: Lab I-Bio-organic & Bio-inorganic Chemistry** **Examination (Duration): 06 hours** **Examination (Marks): 30** **Internal: 20**

Sr. No.	List of Practicals
I	Qualitative and quantitative analysis of Carbohydrates: 1. Separation of a mixture of two sugars by ascending paper chromatography 2. Differentiate between a reducing/ nonreducing sugar 3. Synthesis of Osazones.
II	Qualitative and quantitative analysis of Proteins, amino acids and Fats 1. Isolation of protein. 2. Determination of protein by the Biuret reaction. 3. TLC separation of a mixture containing 2/3 amino acids 4. Paper chromatographic separation of a mixture containing 2/3 amino acids 5. Action of salivary amylase on starch 6. To determine the concentration of glycine solution by formylation method. 7. To determine the saponification value of an oil/fat. 8. To determine the iodine value of an oil/fat
III	Determination and identification of Nucleic Acids 1. Determination of nucleic acids 2. Extraction of DNA from onion/cauliflower Synthesis of Simple drug molecules 1. To synthesize aspirin by acetylation of salicylic acid and compare it with the ingredient of an aspirin tablet by TLC. 2. Synthesis of barbituric acid 3. Synthesis of propranolol