	P.R.GOVERNMENT COLLEGE(A),KAKINADA	Program & Semester II B. Sc., Pharmaceutical chemistry SEM: II			
Course Code PHCH:05	**TITLE OF THE COURSE** **PHARMACEUTICS – II** **COURSE: V**				
Teaching	Hours Allocated: (**Theory**)	L	T	P	C
Pre-requisites	fundamental knowledge on different conventional dosage forms.	45	10	30	4+1

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

i. Size reduction methods in the manufacture of tablets
ii. Size separation methods in the manufacture of tablets
iii. Different sterilization processes
iv. Manufacture of Parenterals

COURSE OUTCOMES

On Completion of the course, the students will be able to	
CO1	Understand the concept of size reduction and illustration of various equipment'sUsed
CO2	Understand the concept of mixing and homogenizations and various equipments usedfor the process
CO3	Apply the sterilization process in the pharma industry using various types ofsterilization process
CO4	Perform the manufacturing and evaluation of parenterals in an aseptic environmentto prevent contamination

SYLLABUS

UNIT: I

Size reduction, objectives, and factors affecting size reduction, methods of sizereduction- study of Hammer mill, ball mill, Fluid energy mill and Disintegrator.

Size separation-size separation by sifting. Official standards for powders. Sedimentation methods of size separation. Construction and working of Cycloneseparator.

UNIT : II

Mixing and Homogenization-Liquid mixing and powder mixing, Mixing of semisolids. Study of Propeller mixer, planetary mixer, silverson Mixer-Homogenizer, Hand homogeniser; double cone mixer; Triple Roller Mill

Clarification and Filtration –Theory of filtration, Filter media; Filter aids and selection of filters. Study of the

following filtration equipments–Filter Press, SinteredFilters, Filter Candles, Metafilter.

UNIT: III

Sterilization–Concept of sterilization and its differences from disinfection–Thermal resistance of micro–organisms. Detailed study of the following sterilization process.

Sterilization with moist heat, (ii) Dry heat sterilization,(iii) Sterilization by radiation, (iv) Sterilization by filtration and (v) Gaseous sterilization.

UNIT : IV

Parenterals Preparations- Routes of administration of parental products-Types ofparental products-Formulation of parental products-Aseptic work to prevent contamination-Manufacturing of Parenterals-Evaluation of Parenterals.

OPHTHALMIC PRODUCTS

Definition, Characteristics of ideal ophthalmic products, types of ophthalmic products-eye drops-factors effecting formulation of eye drops, containers for eyedrop. Eye lotions, Contact lens-types of contact lens, storage solution of contact lens

UNIT : V

DENTAL & COSMETIC PRODUCTS

Definition of Dentifrices, Characteristics of ideal Dentifrices, ingredients of Dentifrices, tooth paste, tooth powder.

Definition of cosmetics, classification of cosmetics

cold creams, lipsticks,deodorants, shampoos, shaving cream, sunscreen products and baby care products

TEXT BOOKS

1. Prof. K. Samba Murthy, Pharmaceutical Engineering.
2. Badzer & Banchero, Introduction to Chemical Engineering.
3. C.V.S. Subramanayam, Pharmaceutial Unit Operation, VallabhPrakashan 4. S.J. Carter, Cooper and Gunn's Tuto rial Pharmacy 6ed CBS publisher, Delhi.

REFERENCES

1. Perry's Handbook of Chemical Engineering.
2. Unit Operations by McCabe& Smith.
3. Lippincott Williams and Wilkins: Remington Pharmaceutical Sciences.
4. EA Rawlins, Bently's Text Book of Pharmaceutics, 8th edition, ELBS
5. C.G. Brown, Unit Operations (Indian ed) Asia Publishing House, Bombay

Remington's Pharmaceutical Sciences

CO-POMapping:

(1:Slight[Low]; 2:Moderate [Medium]; 3:Substantial [High], '-':No Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	2	3	2	3	3	3	1	2	2	3	2	3	3
CO2	3	2	3	3	2	3	3	1	3	3	2	3	2
CO3	3	3	3	3	2	2	2	2	2	3	3	3	2
CO4	3	2	2	2	2	2	3	3	1	1	3	3	3
Avg.	**2.75**	**2.5**	**2.5**	**2.75**	**2.25**	**2.5**	**2.25**	**2**	**2**	**2.5**	2.5	3	2.5

PO1 : Knowledge in Pharmaceutical Chemistry : Apply the knowledge of different dosage forms and their routes of administration.

PO2: Problem analysis: Identify, formulate, review research literature, and analyze simple to complex problems reaching substantiated conclusions using fundamental principles of pharmaceutical chemistry.

PO3: Design/development of solutions: Design solutions for simple to complex problems and designing novel routes for the synthesis of bioactive / active pharmaceutical ingredients.

PO4: Conduct investigations on new drug discoveries: Use fundamental research-based knowledge and available research methodologies including design of experiments, analysis and interpretation of data, and synthesis of the drug molecules.

PO5 : Modern tool usage: Create, select, and apply appropriate techniques, resources, and IT tools for drug modeling and interpretation of simple to complex drug molecules. PO6 : Society: Applying the contextual knowledge to assess societal, health, safety, legal issues.

PO7: Environment and sustainability: Understand the importance of synthetic drug chemistry for various discoveries in the field of health science and demonstrate the knowledge for sustainable development.

PO8 : Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the pharmaceutical manufacturing practice.

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PO10: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change new drug investigations for new diseases.

PSO-1: To have a firm foundation in the fundamentals/concepts/theories and its applications in pharmaceutical chemistry.

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WEIGHTAGETOCONTENT

S No.	Course Content	Essay (10M)	Short (5M)	Total marks	Question Relates as per Bloom's Taxonomy
1.	UNIT-I	1	2	20	Remembering, understanding
2.	UNIT-II	2	1	25	Analyzing, Remembering
3.	UNIT-III	1	2	20	Analyzing, Remembering
4.	UNIT-IV	1	1	15	Analyzing, Evaluating
5.	UNIT-V	1	1	15	Evaluating
	Total	6	7	95	

MODEL QUESTION PAPER

Time2hrs **Max.Marks-50**

SECTION-A

Answer any THREE questions choosing at least ONE question from each section 3x10=30M

1. One question is to be set from unit-I
2. One question is to be set from unit-II
3. One question is to be set from unit-II

SECTION-B

4. One question is to be set from unit-III
5. One question is to be set from unit-IV
6. One question is to be set from unit-V

Answer any FOUR questions **4x5=20M**

7. One question is to be set from unit-I
8. One question is to be set from unit-I
9. One question is to be set from unit-II
10. One question is to be set from unit-III
11. One question is to be set from unit-III
12. One question is to be set from unit-IV
13. One question is to be set from unit-V

QUESTION BANK

ESSAY QUESTIONS (10 MARKS)

UNIT -I

1. Write the factors affecting size reduction.
2. Explain the construction and working of hammer mill and ball mill.
3. Explain sedimentation methods for size separation.

UNIT-II

1. Describe working of silverson mixer homogenizer and hand homogeniser
2. Write an essay on (i) Filter press and (ii) Sintered filters.
3. Write an essay on (i) double cone mixer and (ii) Triple Roller mill.

UNIT-III

1. Explain the following.

a) Sterilization by filtration

b) Sterilization by moist heat

2. Explain the following.

a) Sterilization by radiation.

b) Sterilization by Gas

UNIT-IV

1. Describe different routes of administration of Parenterals.
2. Describe the formulation of Parenterals.
3. Explain the steps involved in the manufacture of Parenteral preparations.
4. Explain the factor s affecting the formulation of eye drops.
5. Describe different types of containers for eye drops.

UNIT-V

1. Explain the ingredients of dentifrices.
2. Define cosmetics. Explain the classification of cosmetics.
3. Write briefly on the following.

i. Deodorants

ii. Shampoos

iii. Sunscreen

iv. Babycare products

SHORT QUESTIONS

UNIT-I

1. Write a note on objectives of size reduction.
2. Write a short note on disintegrator.
3. Write a note on construction and working of fluid energy mill.
4. Write about official standards for powders.

UNIT-II

1. Write a note on homogenization and mixing.
2. Define clarification and filtration and write about filter media
3. Define clarification and filtration and write about filter media
4. write about filter candles and metafilter
5. write about propeller mixer and planetary mixer
6. Describe liquid mixing and powder mixing

UNIT-III

1. Explain the concept of sterilization. How does it differ from disinfection?
2. Write about thermal resistance of micro organisms.
3. Write a short note on dry heat.

UNIT-IV

1. What are the essential qualities of a parental product.
2. Define parental preparation and types of parental preparation
3. What are ophthalmic preparations? Write different types of ophthalmic products.
4. Write the characteristics of ideal ophthalmic products.
5. Write the characteristics of eye ointments.
6. What are contact lens solutions? Write different types of contact lens.

UNIT – V

1. Write the characteristics of ideal dentifrices.
2. Write the preparation of toothpaste.
3. Write the preparation of tooth powder

PRACTICALS :

1.Evaluation of factors effecting rate of filtration

2.Preparation and submit zinc starch dusting powder

3.Determination of particle size distribution by sieving method

4.Preparation of ascorbic acid injection

5.Preparations involving ophthalmic preparation : Any 2 preparations

6.Preparation of cold Creams

7.Preparation of vanishing cream

SCHEME OF VALUATION

Component	Marks Allotted
Writing the Principle& Proceedure	**10 Marks**
Prepararion of Solutions	**5 Marks**
Calculation	**10 Marks**
Accuracy of Result	**15 Marks**
Record Submission	**5 Marks**
Viva Voce	**5 Marks**
Total	**50 Marks**

	P.R.GOVERNMENT COLLEGE(A),KAKINADA	Program & Semester II B. Sc., Pharmaceutical chemistry SEM:II			
Course Code PHCH: 06	**TITLE OF THE COURSE PHARMA REGULATORY AFFAIRS COURSE: VI**				
Teaching	Hours Allocated: (**Theory**)	L	T	P	C
Pre-requisites	fundamental knowledge on different conventional dosage forms.	45	10	30	4+1

Course Objectives :

I. To make the student
II. Understand the different types of hazards
III. Understand the Good laboratory practices.
IV. Understanding the Investigation of new drug.

On Completion of the course, the students will be able to	
CO1	The Pharmaceutical legislations and their implications in the development and marketing of pharmaceuticals.
CO2	The regulatory authorities and agencies governing the manufacture and sale of Laws pharmaceuticals
CO3	Know different and Acts that regulate pharmaceutical industry.
CO4	Learn marketing of pharmaceuticals

SYLLABUS

UNIT :I

Good laboratory Practice, responsibilities of personnel Standard operating procedure, Standard Testingprocedure, Certificate of Analysis, Method of Analysis, good receipt note.

UNIT : II

Approval of new drugs-Investigational New Drugs (IND) submission, format & content of IND, content of investigator Brochure, general consideration of new drugApproval (NDA), specific requirements, content & format of NDA, manufacturing control requirement of NDA,

UNIT-III

GMP, ISO 9000, TQM, ICH, CGMP

UNIT:IV

Occupational Health and Hazards, Safety at workplace, Accident preventiontechniques, Safety Management system, list of hazardous chemicals and handling of toxic andhazardous chemicals, acids,ether & etc.

UNIT-V

Clinical Trials: Phase –I, II, III & IV, A Study of Intellectual Property Rights : Definitions – Guidelines – National and international – Examples. Patents: patenting laws and Regulations – Procedures for obtaining and writing a patent – Examples.

TEXT BOOKS

1. How to Practice GMPs By P.P.Sharma, Vandhana Publications, Agra.
2. Quality Assurance and Quality Management in Pharmaceutical Industry, Anjaneyulu Y.
3. Good Manufacturing Practices and Inspection, W.H.O, Vol – II.
4. I.P.R: Hand book for pharma students and researchers, Bansal.

References :

1. Quality Assurance guide by organization of Pharmaceutical Procedures of India
2. Drug formulation manual by D.P.S.Kohli and D.H.Shah. Eastern Publishers, New Delhi.
3. Pharmaceutical Process Validation by FRA.R.Berry and Robert.A.Nash.

CO-POMapping:

(1:Slight[Low]; 2:Moderate [Medium]; 3:Substantial [High], '-':No Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	2	3	2	3	3	3	1	2	2	3	2	3	3
CO2	3	2	3	3	2	3	3	1	3	3	2	3	2
CO3	3	3	3	3	2	2	2	2	2	3	3	3	2
CO4	3	2	2	2	2	2	3	3	1	1	3	3	3
Avg.	**2.75**	**2.5**	**2.5**	**2.75**	**2.25**	**2.5**	**2.25**	**2**	**2**	**2.5**	2.5	3	2.5

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interpretation of data, and synthesis of the drug molecules.

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WEIGHTAGETOCONTENT

S No.	Course Content	Essay (10M)	Short (5M)	Total marks	Question Relates as per Bloom's Taxonomy
1.	UNIT-I	1	2	20	Remembering, understanding
2.	UNIT-II	2	1	25	Analyzing, Remembering
3.	UNIT-III	1	2	20	Analyzing, Remembering
4.	UNIT-IV	1	1	15	Analyzing, Evaluating
5.	UNIT-V	1	1	15	Evaluating
	Total	6	7	95	

MODEL QUESTION PAPER

Time2hrs **Max.Marks-50**

SECTION-A

Answer any THREE questions choosing at least ONE question from each section **3x10=30M**

SECTION-A

1. One question is to be set from unit-I
2. One question is to be set from unit-II
3. One question is to be set from unit-II

SECTION-B

4. One question is to be set from unit-III
5. One question is to be set from unit-IV
6. One question is to be set from unit-V

Answer any FOUR questions **4x5=20M**

7. One question is to be set from unit-I
8. One question is to be set from unit-I
9. One question is to be set from unit-II
10. One question is to be set from unit-III
11. One question is to be set from unit-III
12. One question is to be set from unit-IV
13. One question is to be set from unit-V

QUESTION BANK

ESSAY QUESTIONS

UNIT-1

1. Write an essay on GLP
2. Why are the reserve samples maintained.
3. State the contents of S O P on handling of the rejecting material.

UNIT-II

1. What are the content of NDA.
2. What are the content of IND.
3. Explain the submission of IND.

UNIT-III

1. Write about ICH guidelines
2. Write about GMP and CGMP

UNIT-IV

1. Write a note on first aid
2. List out the hazardous chemicals in pharmaceuticals.
3. Describe various safety rules at work place.

UNIT-V

1. Write about the different phases in clinical trails
2. Write about the procedure for obtaining a patent
3. Describe about IPR

SHORT QUESTIONS

UNIT-I

1. Write about certificate of Analysis
2. Write the prinicples of GLP
3. Write about generating STP

UNIT-II

1. Explain the content of investigator Brochure.
2. What are the specific requirements, content & format of NDA
3. What are the manufacturing control requirement of NDA.

UNIT-III

1. Define GMP protocol
2. Write a note on USFDA
3. Write a note on CDSCO

UNIT-IV

1. Write about personnel protective equipment
2. Write about fire extinguishers
3. Write about safety signs and signal

UNIT-V

1. Describe about copyrights and trade marks
2. Outline the procedure for applying a patent
3. What is patent. Write about its regulations.

PRACTICALS:

Give the application and format of NDA

Give the application and format of INDA

Analytical method validation

Assignment on product development filing to various regulatory authorities

SOP for the following equipments :

Dissolution apparatus, disintegrator, friabilator, hot air oven

SCHEME OF VALUATION

Component	Marks Allotted
Writing the Principle& Proceedure	**10 Marks**
Prepararion of Solutions	**5 Marks**
Calculation	**10 Marks**
Accuracy of Result	**15 Marks**
Record Submission	**5 Marks**
Viva Voce	**5 Marks**
Total	**50 Marks**

	PITHAPUR RAJAH'S GOVERNMENT COLLEGE(A) KAKINADA DEPARTMENT OF CHEMISTY	Program & Semester II B.Sc. (PHARMA) (III Semester)			
Course Code PHCH07	TITLEOFTHECOURSE **COURSE PC-7: FUNDAMENTALS IN ORGANIC CHEMISTRY**				
Teaching	HoursAllocated:45 (**Theory**)	L	T	P	C
Pre-requisites	Nature of bonds, Field effects, aromaticity, alicyclic compounds. Saturated & Unsaturated Hydrocarbons	45	10	30	3+1

CourseOutcomes:

On Completion of the course, the students will be able to	
CO1	Understand the types of bond fission, organic reagents, and reaction intermediates (Carbocations, Carbanions, Free Radicals).
CO2	Analyze the effects of bond polarization, inductive, resonance, and hyperconjugation in organic molecules.
CO3	Comprehend the methods of preparation of alkanes and cycloalkanes, including Wurtz and Wurtz Fittig reactions.
CO4	Study the conformational analysis of alkanes and cycloalkanes, including energy diagrams and relative stability
CO5	Learn the preparation, properties, and mechanisms of alkenes and alkynes, including electrophilic additions and elimination reactions.
CO6	Study advanced reactions like ozonolysis, Diels-Alder reactions, and the alkylation of terminal alkynes.
CO7	Understand the structure of benzene and its electrophilic aromatic substitution mechanisms
CO8	Study the preparation and reactions like Friedel-Craft alkylation, acylation, halogenation, and nitration.
CO9	Learn the concept of aromaticity, Huckel's rule, and apply it to both benzenoid and non-benzenoid compounds
CO10	Understand the orientation of aromatic substitution and electronic interpretation of activating and deactivating groups.

Syllabus:

UNIT-I

STRUCTURAL THEORY IN ORGANIC CHEMISTRY (9 Hrs.)

Types of bond fission and organic reagents (Electrophilic, Nucleophilic, and free radical reagents). Reaction intermediates – Carbocations, carbanions & free radicals. Bond polarization: Factors influencing the polarization of covalent bonds, inductive effect – Application of inductive effect (a)Basicity of amines (b) Acidity of carboxylic acids (c) Stability of carbonium ions. Resonance or Mesomeric effect, application to (a) acidity of phenol, and (b) acidity of carboxylic acids. Hyperconjugation and its application to stability of carbonium ions, Free radicals, and alkenes

UNIT-II

SATURATED HYDROCARBONS (ALKANES AND CYCLOALKANES) (9 Hrs.)

General methods of preparation of alkanes- Wurtz and Wurtz Fittig reaction, Corey House synthesis, physical and chemical properties of alkanes, Conformational analysis of alkanes (Conformations, relative stability and energy diagrams of Ethane, Propane, and butane). General molecular formulae of cycloalkanes and relative stability, Baeyer strain theory, Cyclohexane conformations with energy diagram, Conformations of monosubstituted cyclohexane.

UNIT-III

UNSATURATED HYDROCARBONS (ALKENES AND ALKYNES) (9 Hrs.)

General methods of preparation, physical and chemical properties, Saytzeff and Hoffmann eliminations (with mechanism), Electrophilic Additions, (H2, HX) mechanism (Markonikoff's/ Anti Markonikoff's addition) with suitable examples-syn and anti-addition. addition of X2, HX. Oxymercuration demercuration, ozonolysis, hydroxylation, Diels Alder reaction,1,2- and1,4-addition reactions in conjugated dienes. Reactions of alkynes; acidity, electrophilic and nucleophilic additions, hydration to form carbonyl compounds, Alkylation of terminal alkynes

UNIT-IV

BENZENE AND ITS REACTIVITY(9 Hrs.)

Structure of Benzene – Preparation - polymerization of acetylene and decarboxylation- Properties - mechanism of electrophilic aromatic substitution of Friedel- Craft's alkylation and acylation. halogenation and nitration.

UNIT-V

Orientation of aromatic substitution (9 h)

Concept of aromaticity, Huckel's rule - application to Benzenoid (Benzene, Naphthalene) and Non - Benzenoid compounds (cyclo propenyl cation, cyclopentadienyl anion and tropylium cation) Orientation of aromatic substitution - ortho, para and meta directing groups. Ring activating and deactivating groups with examples (Electronic interpretation of various groups like NO2 and Phenolic). Orientation of (i) Amino, methoxy and methyl groups (ii) Carboxy, nitro, nitrile, Carbonyl and sulphonic acid groups (iii) Halogens.

Textbooks:

S.NO	AUTHOR	TITLE	PUBLISHER
1	O.P Agarwal	Unified Chemistry	JPNP publications
2	Bhal and Arun Bhal	Textbook of Advanced organic chemistry	S.Chand publications

Reference books

S.NO	AUTHOR	TITLE	PUBLISHER
1	Morrison and Boyd	Organic Chemistry	Oxford University Press
2	I L Finar Vol I	A Text Book of Organic chemistry	
3	Jonathan Clayden, Greeves and Stuart Warren.	Organic Chemistry	Oxford University Press

WebLinks:

1. https://www.sandiego.edu/documents/cas/chemistry/structure_function.pdf
2. https://www.youtube.com/watch?v=ib9h_vM4Kp4
3. https://chem.libretexts.org/Bookshelves/Organic_Chemistry/Cyclohexane_Conformations
4. https://www.youtube.com/watch?v=gU8bKZ8IJpU
5. https://www.masterorganicchemistry.com/2010/09/22/the-diels-alder-reaction/
6. https://chem.libretexts.org/Bookshelves/Organic_Chemistry/Electrophilic_Aromatic_Substitution.pdf
7. https://nptel.ac.in/courses/104/103/104103071/
8. https://chem.libretexts.org/Bookshelves/Organic_Chemistry/Aromaticity.pdf
9. https://en.wikipedia.org/wiki/Electrophilic_aromatic_directing_groups

COURSE OUTCOME & PROGRAM OUTCOME MAPPING

CO-PO Mapping:

1: Low =1 ; 2: Moderate = 2 ; 3: High = 3

CO	PO1 Knowledge	PO2 Critical Thinking	PO3 Problem Solving	PO4 Usage of Modern Tools	PO5 Communication	PO6 Life-long Learning	PO7 Ethical Practices and Social Responsibility	BT LEVELS
CO1	3	2	2	2	1	1	1	BT2
CO2	3	3	2	2	1	1	1	BT4
CO3	3	2	2	2	1	2	1	BT3
CO4	3	3	3	3	1	2	1	BT4
CO5	3	3	3	3	1	2	1	BT3
CO6	3	3	3	3	1	2	1	BT3
CO7	3	3	2	2	1	2	1	BT2
CO8	3	3	3	2	1	2	1	BT3
CO9	3	3	2	2	1	2	1	BT2
CO10	3	3	3	2	1	2	1	BT4

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Weightage to content

Semester -III

Course – PC-7

S.No	Course Content	Long Answer	Short Answer	Total marks	As per Blooms Taxonomy
1	STRUCTURAL THEORY IN ORGANIC CHEMISTRY	2	1	25	Understanding, Application
2	ALKANES AND CYCLO ALKANES	1	2	20	Remembering, Understanding
3	ALKENES AND ALKYNES	1	1	15	Analyzing & Creation
4	BENZENE AND IT'S REACTIVITY	1	1	15	Evaluation, Understanding
5.	ORIENTATION OF AROMATIC SUBSTITUTION.	1	2	20	Understanding, Application
	TOTAL	**6**	**7**	**95**	

P.R. GOVERNMENT COLLEGE (A), KAKINADA

II YEAR B.Sc Pharma Chemistry

(Examination at the end of III semester)

(COURSE –PC-7 Fundamentals In Organic Chemistry)

MODEL PAPER

Duration: 2hr **Max.Marks:50M**

Section – 1

Answer any three of the following questions. Must attempt at least one question from each part. Each question carries 10 Marks. **3 X 10M = 30M**

Part -A

1. UNIT- 1
2. UNIT -1
3. UNIT- 2

Part-B

4. UNIT-3
5. UNIT4
6. UNIT 5

Section – II

Answer any four of the following questions. Each carries 5 marks. **4 X 5M= 20M**

7.UNIT- 1

8. UNIT- 2

9. UNIT- 2

10. UNIT- 3

11.U INIT -3

12.UNIT- 4

13.UNIT -5

SEMESTER-III

COURSE -PC-7: ORGANIC CHEMISTRY

Practical Credits: 1 2 hrs/week

Learning Out comes:

On successful completion of this practical course, student shall be able to (At the end of Semester)

1. Use glassware, equipment and chemicals and follow experimental procedures in the laboratory
2. Determine melting and boiling points of organic compounds
3. Understand the application of concepts of different organic reactions studied in theory par

Syllabus: Organic Functional Group Reactions

Analysis of an organic compound through systematic qualitative procedure for functional group identification including the determination of melting point and boiling point with suitable derivatives. Alcohols, Phenols, Aldehydes, Ketones, Carboxylic acids, Aromatic primary amines, amides and simple sugars.

Lab References:

S.NO	AUTHOR	TITLE	PUBLISHER
1	Vogel A.I	Practical Organic Chemistry	Longman Group Ltd.
2	Bansal R.K	Laboratory Manual of Organic Chemistry	Wiley-Eastern
3	Ahluwalia & Aggarwal R	Comprehensive Practical Organic Chemistry	Universitypress. Delhi
4	Mann F.G and Saunders B.C	Practical Organic Chemistry	Pearson Education

Co-Curricular Activities:

a) Mandatory:(Lab/field training of students by teacher:(lab:10+field:05):

1. For Teacher: Training of students by teacher in laboratory and field for not lessthan15 hours on the field techniques/skills of preparation of acetanilide, preparation of azodye, use of separating funnel for solvent extraction, separation of organic compounds in a mixture.
2. For Student: Student shall visit a related industry/chemistry laboratory in universities/research organizations/private sector facility and observe the techniques used for the separation of organic compounds. Write their observations and submit a hand written fieldwork/project work report not exceeding10 pages in the given format to the teacher.
3. Max marks for Fieldwork/project work Report:05.

4.Suggested Format for Fieldwork/project work: Title page, student details, index page, details of place visited, observations, findings, and acknowledgements.

4. Unit tests (IE).

b) Suggested Co-Curricular Activities

1. Training of students' by related industrial experts.
2. Assignments, Seminars and Quiz (on related topics), collection of videos and other material.
3. Visits of facilities, firms, research organizations etc.
4. Invited lectures and presentations on related topics by field/industrial experts

SCHEME OF VALUATION

Practical Paper – PC-7:: Organic Chemistry (at the end of semester III)

Systematic analysis of each component which involves following	
a. Preliminary Tests (State, Colour, Odour)	03 marks
b. Ignition test	02 marks
c. Detection of the functional group (Preliminary & Confirmation)	02+03 marks
Total Four compounds (4 X 10)	40M
d. Viva voce	05M
e. Record	05M
TOTAL	**50 marks**

QUESTION BANK

Unit 1: Structural Theory in Organic Chemistry

Long Answer Questions (10 Marks)

1. Explain the different types of bond fission in organic reactions and their significance.
2. Discuss the concept of resonance and its application to the acidity of phenols and carboxylic acids.
3. Describe the factors influencing the polarization of covalent bonds.
4. What is hyperconjugation? Discuss its role in the stability of carbocations and free radicals.
5. Explain the inductive effect and its application in the basicity of amines and the acidity of carboxylic acids.

Short Answer Questions (5 Marks)

1. Define the concept of free radicals and provide examples.
2. What is the role of carbocations in organic reactions?
3. State the effect of hyperconjugation on the stability of alkenes.
4. What is the application of resonance in organic chemistry?
5. Discuss the concept of bond polarization and its importance in organic reactions.

Unit 2: Saturated Hydrocarbons (Alkanes and Cycloalkanes)

Long Answer Questions (10 Marks)

1. Discuss the methods of preparation of alkanes with a focus on the Wurtz and Wurtz-Fittig reactions.
2. Explain the conformational analysis of alkanes, including the energy diagrams of ethane, propane, and butane.
3. Discuss the molecular structure and stability of cycloalkanes, highlighting Baeyer's strain theory.
4. What are the properties of alkanes, and how do they influence the chemical reactions they undergo?
5. Compare the stability of different conformations of cyclohexane.

Short Answer Questions (5 Marks)

1. Write a short note on the physical properties of alkanes.
2. What is the Corey House synthesis?
3. Explain Baeyer's strain theory and its relevance to cycloalkanes.
4. What is the significance of the conformational analysis of ethane?
5. How does the molecular formula affect the stability of cycloalkanes?

Unit 3: Unsaturated Hydrocarbons (Alkenes and Alkynes)

Long Answer Questions (10 Marks)

1. Describe the mechanism of electrophilic addition in alkenes, focusing on the Markovnikov's and Anti-Markovnikov's additions.
2. Discuss the Saytzeff and Hoffmann eliminations with suitable examples.
3. Explain the mechanism and importance of ozonolysis in alkenes.

4. Discuss the reactions of alkynes, including their acidity, electrophilic additions, and nucleophilic additions.
5. Explain the Diels-Alder reaction with mechanisms and its significance in organic synthesis.

Short Answer Questions (5 Marks)

1. What is the mechanism of electrophilic addition in alkenes?
2. Write a note on the hydration of alkynes to form carbonyl compounds.
3. Describe the process of syn and anti-addition in alkenes.
4. What is the significance of ozonolysis in organic chemistry?
5. Explain the 1,2- and 1,4-addition reactions in conjugated dienes.

Unit 4: Benzene and its Reactivity

Long Answer Questions (10 Marks)

1. Explain the structure of benzene and its resonance properties.
2. Describe the mechanism of electrophilic aromatic substitution with examples of Friedel-Crafts alkylation and acylation.
3. Discuss the polymerization of acetylene and its role in organic chemistry.
4. Explain the decarboxylation of benzene derivatives with examples.
5. Discuss the electrophilic aromatic substitution reactions with a focus on nitration and halogenation.

Short Answer Questions (5 Marks)

1. What is the mechanism of Friedel-Crafts alkylation?
2. Write a short note on the polymerization of acetylene.
3. Discuss the halogenation reaction of benzene.
4. What is the decarboxylation of benzene derivatives?
5. Explain the concept of aromaticity and its importance in organic chemistry.

Unit 5: Orientation of Aromatic Substitution

Long Answer Questions (10 Marks)

1. Explain the concept of aromaticity and Huckel's rule with examples from benzenoid and non-benzenoid compounds.
2. Discuss the orientation of aromatic substitution in terms of electron-donating and electron-withdrawing groups.
3. Describe the effect of activating and deactivating groups on the orientation of aromatic substitution.
4. Discuss the electronic interpretation of groups like NO2 and phenolic on aromatic substitution.
5. Explain the effects of amino, methoxy, and methyl groups on the orientation of aromatic substitution.

Short Answer Questions (5 Marks)

1. What is Huckel's rule? Explain its application to benzene.
2. Discuss the effect of halogen groups on aromatic substitution.
3. Explain the concept of ortho-para and meta-directing groups in aromatic substitution.
4. What are activating and deactivating groups in the context of aromatic substitution?
5. Discuss the role of methyl and methoxy groups in the orientation of aromatic substitution.

P.R.GOVERNMENT COLLEGE(A), KAKINADA.

Course Code 08	**TITLE OF THE COURSE** PHYSICAL CHEMISTRY	**Program & Semester** II B. Sc., **Pharmaceutical chemistry** (SEMESTER-III)			
Teaching	Hours Allocated: 45 (**Theory**)	L	T	P	C
Pre-requisites	1. **Basic Understanding of General Chemistry:** Atomic structure, chemical bonding, states of matter, and basic chemical reactions. 2. **Fundamental Knowledge of Mathematics:** Algebra, logarithms, and basic calculus concepts (useful for understanding equations of state, derivations, and numerical problems). 3. **Prior Exposure to Solution Chemistry:** Familiarity with types of mixtures, solubility, concentration terms, and basic properties of solutions. 4. Knowledge of pressure, temperature, volume relationships, and simple physical measurements.	45	10	30	4+1

Course Objectives:

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

1. **To enable students to understand** the fundamental concepts of crystal structure, symmetry elements, unit cells, Bravais lattices, and the application of X-ray diffraction in determining crystal structures.
2. **To develop a comprehensive understanding** of the behaviour of real gases, critical phenomena, and thermodynamic concepts such as the Joule-Thomson effect and inversion temperature.
3. **To introduce the concept of liquid crystals,** their classification, properties, and practical applications in modern display technologies like LCDs.
4. **To provide knowledge and problem-solving skills** related to solutions, ionic equilibria, colligative properties, and methods for determining molar masses of solutes in dilute solutions.

PC-8 : PHYSICAL CHEMISTRY SYLLABUS

UNIT-I Solid state 10h

Symmetry in crystals. Law of constancy of interfacial angles. The law of rationality of indices. The law of symmetry. Miller indices, Definition of lattice point, space lattice, unit cell. Bravais lattices and crystal systems. X-ray diffraction and crystal structure. Bragg's law.

UNIT-II Gaseous state 6h

van der Waals' equation of state. Critical phenomena. Relationship between critical constants and van der Waals' constants. Joule-Thomson effect. Inversion temperature.

UNIT-III Liquid state 4h

Liquid crystals, mesomorphic state. Differences between liquid crystal and solid/liquid. Classification of liquid crystals into Smectic and Nematic. Application of liquid crystals as LCD devices.

UNIT-IV Solutions, Ionic equilibrium 6h

Solutions : Azeotropes- ethanol-water system. Partially miscible liquids-phenol water system. Critical solution temperature (CST), Nernst distribution law. Applications of distribution law.

Ionic equilibrium :Ionic product, common ion effect, solubility and solubility product. Calculations based on solubility product.

UNIT-V Dilute solutions 7h

Colligative properties- RLVP, Osmotic pressure, Elevation in boiling point and depression in freezing point. Experimental method for the determination of molar mass of a non-volatile solute using osmotic pressure, abnormal colligative properties. Van't Hoff factor.

COURSE OUTCOMES	
On Completion of the course, the students will be able to	
CO1	Understand and apply the fundamental principles of crystal symmetry, unit cells, Bravais lattices, and X-ray diffraction to determine the crystal structure using Bragg's Law.
CO2	Analyze the behavior of real gases using van der Waal's equation, interpret critical phenomena, and explain Joule-Thomson effect along with the concept of inversion temperature.
CO3	Differentiate between the properties of solid, liquid, and liquid crystal phases, classify types of liquid crystals, and describe their technological applications, especially in LCD devices.
CO4	Explain and solve numerical problems related to solutions, azeotropes, partially miscible liquids, ionic equilibrium, and colligative properties, including the determination of molar mass and the effect of solutes on physical properties.

PO1 : Knowledge in Pharmaceutical Chemistry: Apply the knowledge of different dosage forms and their routes of administration.

PO2: Problem analysis: Identify, formulate, review research literature, and analyze simple to complex problems, reaching substantiated conclusions using fundamental principles of pharmaceutical chemistry.

PO3: Design/development of solutions: Design solutions for simple to complex problems and design novel routes for the synthesis of bioactive/active pharmaceutical ingredients.

PO4: Conduct investigations on new drug discoveries: Use fundamental research-based knowledge and available research methodologies, including design of experiments, analysis and interpretation of data, and synthesis of the drug molecules.

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and IT tools for drug modeling and interpretation of simple to complex drug molecules.

PO6 : Society: Applying the contextual knowledge to assess societal, health, safety, legal issues.

PO7: Environment and sustainability: Understand the importance of synthetic drug chemistry for various discoveries in the field of health science and demonstrate the knowledge for sustainable development.

PO8 : Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the pharmaceutical manufacturing practice.

PO9 : Communication: Communicate effectively on issues related to pharmaceutical chemistry with the medical community, being able to write the effective reports and documentations and presentations.

PO10: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change new drug investigations for new diseases.

PSO-1: To have a firm foundation in the fundamentals/concepts/theories and its applications in pharmaceutical chemistry.

PSO-2: To understand the structure and properties of drugs, Characteristics mechanisms of chemical reactions and their usage in pharmaceutical chemistry

PSO-3: To acquaint with safety measures that are to be taken in pharmaceutical chemistry laboratory and develop skills in proper manufacturing methods of pharmaceuticals and usage of different apparatus/instruments and carry out experimental procedures, record the observations and results and present the inference/conclusion

CO-POMapping:

(1:Slight[Low]; 2:Moderate [Medium]; 3:Substantial [High], '-' : No Correlation)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
CO1	3	2	2	2	3	-	2	3	2	2	3	3	2
CO2	3	3	2	2	3	-	2	3	2	3	3	3	2
CO3	3	2	3	2	3	2	3	3	3	2	3	3	3
CO4	3	3	3	3	3	2	3	3	3	3	3	3	3
Average	3.0	2.5	2.5	2.3	3.0	1.0	2.5	3.0	2.5	2.5	3.0	3.0	2.5

WEIGHTAGE TO CONTENT

S No.	Course Content	Essay (10M)	Short (5M)	Total marks	Question Relates as per Bloom's Taxonomy
1.	UNIT-I	1	2	20	Remembering, understanding
2.	UNIT-II	2	1	25	Analyzing, Remembering
3.	UNIT-III	1	2	20	Analyzing, Remembering
4.	UNIT-IV	1	1	15	Analyzing, Evaluating
5.	UNIT-V	1	1	15	Evaluating
	Total	6	7	95	

PC-8 PHYSICAL CHEMISTRY

MODEL QUESTION PAPER

Time2hrs **Max.Marks-50**

SECTION-A

Answer any THREE questions choosing at least ONE question from each section 3x10=30M

SECTION-A

1.One question is to be set from unit-I

2.One question is to be set from unit-II

3.One question is to be set from unit-II

SECTION-B

4.One question is to be set from unit-III

5.One question is to be set from unit-IV

6.One question is to be set from unit-V

Answer any FOUR questions **4x5=20M**

7.One question is to be set from unit-I

8.One question is to be set from unit-I

9.One question is to be set from unit-II

10.One question is to be set from unit-III

11.One question is to be set from unit-III

12.One question is to be set from unit-IV

13.One question is to be set from unit-V

QUESTION BANK

Unit-I: Solid State (10 hours)

Essay Questions:

1. **Explain the symmetry elements in crystals and state the laws of crystal symmetry.**
2. **Define Miller indices. How are they calculated? Write their significance.**
3. **Discuss the different types of Bravais lattices and crystal systems with examples.**
4. **Describe the principle of X-ray diffraction and explain Bragg's Law with its derivation.**
5. **Write detailed notes on the laws of constancy of interfacial angles, rationality of indices, and symmetry in crystals.**

Short Answer Questions:

1. **What is a lattice point and a unit cell?**
2. **State the law of constancy of interfacial angles.**
3. **What are Miller indices? Give an example.**
4. **Define space lattice.**
5. **Write Bragg's equation and explain the terms involved.**
6. **List the seven crystal systems.**

Unit-II: Gaseous State (6 hours)

Essay Questions:

1. **Derive van der Waal's equation of state and explain the significance of its constants.**
2. **Explain the concept of critical phenomena and their relation to van der Waal's constants.**
3. **Discuss the Joule-Thomson effect and its significance. Define inversion temperature.**
4. **Explain the relationship between critical constants and van der Waal's constants.**

Short Answer Questions:

1. **Write van der Waal's equation of state.**
2. **What are critical constants? Give examples.**
3. **Define Joule-Thomson effect.**
4. **What is inversion temperature?**
5. **Write the relation between van der Waal's constants and critical constants.**

Unit-III: Liquid State (4 hours)

Essay Questions:

1. **Explain the properties and classification of liquid crystals.**
2. **Discuss the differences between solids, liquids, and liquid crystals.**

3. **Write a detailed note on the applications of liquid crystals in LCD devices.**

Short Answer Questions:

1. **Define liquid crystals.**
2. **What are smectic and nematic liquid crystals?**
3. **Write any two differences between liquids and liquid crystals.**
4. **Mention two applications of liquid crystals.**

Unit-IV: Solutions and Ionic Equilibrium (6 hours)

Essay Questions:

1. **Explain the concept of azeotropes with a neat diagram. Discuss the ethanol-water system.**
2. **Discuss partially miscible liquids with reference to the phenol-water system and critical solution temperature.**
3. **State and explain Nernst's distribution law and its applications.**
4. **Discuss the concept of solubility product and common ion effect with examples.**
5. **Solve numerical problems related to solubility product.**

Short Answer Questions:

1. **What is an azeotrope? Give an example.**
2. **Define critical solution temperature.**
3. **Write Nernst's distribution law.**
4. **Define common ion effect.**
5. **What is solubility product?**

Unit-V: Dilute Solutions (7 hours)

Essay Questions:

1. **Explain colligative properties and derive an expression for osmotic pressure.**
2. **Describe the method to determine the molar mass of a non-volatile solute using osmotic pressure.**
3. **Discuss the concepts of abnormal colligative properties and van't Hoff factor.**
4. **Explain the elevation in boiling point and depression in freezing point with examples.**

Short Answer Questions:

1. **List the four colligative properties.**
2. **What is osmotic pressure?**
3. **Define van't Hoff factor.**
4. **What are abnormal colligative properties?**
5. **Write the relation between boiling point elevation and molar mass.**

Reference Books:

S. No	Book Title	Author(s)	Publisher
1	Physical Chemistry	P.L. Soni, O.P. Dharmarha, U.N. Dash	Sultan Chand & Sons
2	Principles of Physical Chemistry	B.R. Puri, L.R. Sharma, M.S. Pathania	Vishal Publishing Co.
3	A Textbook of Physical Chemistry	K.L. Kapoor	McGraw-Hill Education
4	Elements of Physical Chemistry	Dr. S. Glasstone	Macmillan India Ltd.
5	Textbook of Physical Chemistry	S.H. Maron and C.F. Prutton	Oxford & IBH Publishing
6	Physical Chemistry for Degree Students (B.Sc. 3rd Year)	R.L. Madan	S. Chand Publishing

Web Links:

1. **Crystalline Solids: Introduction to Solid State Chemistry (YouTube)**
2. **Introduction to Solids – Crystal Lattice (YouTube)**
3. **Solid State Playlist – Crystal Systems & Miller Indices (YouTube)**
4. **Gaseous State – IIT JAM Chemistry (YouTube)**
5. **Gaseous State – Joule Thomson Effect (YouTube)**
6. Liquid Crystals – Basic Concepts (YouTube)
7. Applications of Liquid Crystals (YouTube)
8. Ionic Equilibrium Complete Playlist (YouTube)
9. Nernst Distribution Law Explained (YouTube)
10. Colligative Properties – Theory and Problems (YouTube)

PC- COURSE-8 : LABORATORY COURSE SYLLABUS- 30hrs (2 h / w)

Practical-II Volumetric Analysis

(At the end of Semester-III)

Course outcomes:

The end of the course, the student will be able to;

1. Use glassware, equipment and chemicals and follow experimental procedures in the laboratory

2. Understand and explain the volumetric analysis based on fundamental concepts learnt in ionic equilibria

3. Learn and identify the concepts of a standard solutions, primary and secondary standards

4. Facilitate the learner to make solutions of various molar concentrations. This may include: The concept of the mole; Converting moles to grams; Converting grams to moles; Defining concentration; Dilution of Solutions; Making different molar concentrations.

Volumetric analysis 50 M

1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.

2. Determination of Cu (II) using Na2S2O3 with K2Cr2O7 as primary standard.

3. Estimation of water of crystallization in Mohr's salt by titrating with KMnO4

Reference Books:

- **Practical Chemistry**

Author: O.P. Pandey, D.N. Bajpai, S. Giri ; *Publisher:* S. Chand Publishing

- **A Textbook of Practical Chemistry**

Author: Vogel's Textbook of Quantitative Chemical Analysis (Adapted by G.H. Jeffery et al.)

Publisher: Longman (Indian Edition is widely available)

Web Links:

1. Estimation of Na_2CO_3 and $NaHCO_3$ in a Mixture by Titration (YouTube)
2. Sodium Carbonate and Sodium Bicarbonate Estimation Procedure (YouTube)
3. Estimation of Copper by Iodometry – Stepwise Procedure (YouTube)
4. Copper Estimation by Sodium Thiosulphate Titration (YouTube)
5. Estimation of Mohr's Salt Using $KMnO_4$ – Stepwise Titration (YouTube)
6. Estimation of Water of Crystallization in Mohr's Salt (YouTube)

Scheme of Valuation

Component	Marks Allotted
Writing the Principle	5 Marks
Writing the Balanced Reaction(s)	5 Marks
Preparation of Solution	5 Marks
Calculation Part	10 Marks
Accuracy of Result	15 Marks
Record Submission	5 Marks
Viva Voce	5 Marks
Total	**50 Marks**