Dr. V. S. Krishna Govt. Degree College

(Autonomous)

Visakhapatnam-13

(Affiliated To Andhra University, Visakhapatnam)

Department of Chemistry

Revised Syllabus For Courses in Industrial Chemistry under C.B.C.S.

Board of Studies

2022-23

Dr. V. S. Krishna Govt. Degree College (Autonomous), Visakhapatnam

Recommended Composition of the Board of Studies of chemistry and its functions

(Academic year 2022 – 2023)

Department: Chemistry **Subject: Industrial Chemistry**

I Composition

MEMBER	NAME & DESIGNATION
Head of the Department (Chairman)	Dr. A V RAMESH
Faculty Members	1. Dr. Ch. S. Anuradha 2. Dr. M. Gopi 3. Smt. D. S. L. Prasanna 4. Sri. K. Nageswara Rao 5. Dr. N. Sankara Rao 6. Sri. T. Appa Rao 7. Dr. G. Lakshmana Rao 8. Sri. Ch. V. SaiKrishna 9. Sri. Y. Venkatesh 10.Dr. B. Sudhamsa Prabhakar
Subject Expert (University Nominee)	Sri. R. Venkateswara Rao Lecturer in Chemistry GDC, Srikakulam (men)
Subject Experts (from outside the parent university)	Sri D Adi Narayana Lecturer in Chemistry GDC, Srikakulam (men)
	Sri S Dilleswara rao Lecturer in Chemistry GDC, Tuni
Member from Industry	Sri I. Bhaskara Reddy, Plant Head, Admiron Life Sciences, Visakhapatnam.
Member from Alumni	Dr. Dr.Sathish Mohan Botsa, Research Scientist B, NCAOR, Goa
Coordinator, IQAC	Dr. Ch. Lalitha, Lecturer in Micro Biology
Coordinator, Academic Council	Dr. P. Latha, Lecturer in Physics
Chairperson, Academic Council	Dr. I. Vijaya Babu Principal

II. Term.

The term of the nominated members shall be two years.

III. Meeting

The Principal of the College shall draw the schedule for meeting of the Board of Studies for different Departments. The meeting may be scheduled as and when necessary but at least once a year.

IV. Functions

The Board of Studies of a Department in the College shall:

a) Prepare syllabus and various courses keeping in view the objectives of the College interest of the stakeholders and national requirement for consideration and approval of the Academic Council.

b) Suggest methodologies for innovative teaching and evaluation techniques.

c) Suggest panel of names to the Academic Council for appointment of examiners.

d) Coordinate research, Teaching, Extension and other academic activities in the Department / College.

Dr. V. S. Krishna Govt. Degree College (A)
Department of Chemistry

Minutes of board of studies (BOS) meeting 2021-22 on 30.09. 2022 at 3.00 PM

In pursuance of conferment of Autonomous status to Dr. V. S. Krishna Govt. Degree College (A), Visakhapatnam by the UGC vide letter No. F22-1/2011(AC) dated 20.07.2011 from Dr. Manju Singh, Joint Secretary, UGC, New Delhi and Proceedings No. C-II (1) / Dr. V S Krishna College (A)/ 2022 dt.03.08.2022 of The Vice-Chancellor, Andhra University, Visakhapatnam, the 8th Board of Studies in **Industrial Chemistry** *Subject is conducted on 30. 10. 2022 through offline at* Dr. V. S. Krishna Govt. Degree College (A), *at 3.00 PM.*

Venue: *Conference Hall, Dt: 30. 09. 2022, Friday – 3.00 PM.*

Dr. A. V Ramesh, H O D Dept. of chemistry, University Nominee Sri. R. Venkateswara Rao Lecturer in Chemistry, GDC, Srikakulam (men)., *Subject Experts i)Sri D Adi Narayana, Lecturer in Chemistry, GDC, Srikakulam (men), ii) Sri S Dilleswara Rao, Lecturer in Chemistry, GDC, Tuni,* **Member from Industry** *Sri I. Bhaskara Reddy, Plant Head,, Admiron Life Sciences Pvt. Ltd., Visakhapatnam.,* **Member from Alumni** *Dr. Dr. Sathish Mohan Botsa, Research Scientist B, NCAOR, Goa, Coordinator- IQAC, Dr. Ch. Lalitha, Lecturer in Micro Biology,* **Coordinator, Academic Council** *Dr. P. Latha, Lecturer in Physics,* **Chairperson, Academic Council** *Dr. I. Vijaya Babu, Principal, and all the faculty members of Chemistry Department attended the meeting.*

Agenda:

- *To discuss the Semester System and Choice Based Credit System (CBCS) being implemented for the past 07 years, i.e., w.e.f. 2015-16.*
- *To discuss and approve the Continuation/Modifications of the syllabus for the Odd & Even Semesters of I, II & III Years for 2022-23.*
- *Grant of Extra credits for Online SWAYAM MOOCs etc.*
- *Syllabus, Model Question Papers and Model Blue Prints for I, II, III, IV, V and VI Semesters.*
- *Teaching learning methodology by 75:25 (External: Internal) ratio for the present I, II- and III-Year Students w.e.f. 2022-23 as per C I A SOP issued by APCCE.*
- *Panel of paper setters and examiners.*
- *Proposals for Community Service Projects/Extension activities for the benefit of the society.*

- *Department action plan for 2021-22.*

- *To discuss and resolve the minor modifications/refinement if any, in the Industrial Chemistry SECs (electives) in semester V / VI*

. Any Other Proposal with the Permission of the Chairman.

Resolutions:

The following agenda items are discussed and resolutions are made:

1) *To continue the Revised Choice Based Credit System as per the staff council proceedings for the academic year 2022 – 2023 for Semester I, II, III, IV, V and VI of B. Sc. M C IC students.*

2) *To implement guidelines of academic council and adopt NEP – 2020.*

3) *To approve and implement the newly framed syllabus approved by the B.O.S. for the B. Sc. Degree course in Industrial Chemistry with effect from academic year 2022 – 2023. The newly framed syllabus is oriented in such a way that it caters the needs of the students and to meet the present-day employability and to develop professionalism and enhance skills in the field of chemistry.*

4) *To approve and ratify the syllabus of B. Sc. Degree Industrial Chemistry for the 2021-22 admitted batch.*

5) *To approve and ratify the 5th, 6th semester syllabus of B. Sc. Degree Industrial Chemistry for the 2020-21 admitted batch.*

6) *To continue the semester mode pattern of examinations for Semester I, II, III, IV, V and VI students of the existing groups M.C. IC. Further it is approved and ratified syllabus, blue print and the model question papers submitted by the concerned faculty members for Semester I, II, III, IV, V and VI.*

7) *To approve the continuous internal assessment pattern in accordance with SOP issued by APCCE.*

8) *To approve and ratify value-added certificate course for the academic year 2022-23.*

9) *To approve and ratify new employable and skill-based programs from 2022-23.*

10) ***To approve and ratify life skill courses, skill development courses for the 1st and 2nd year students (B.A., B.Com. and B.Sc.) Chem. (hons.) and Chemistry minors for Physics (hons.).***

11) ***To approve and ratify Community Services Project at the end of II semester and internship -1 at the end of IV semester for 2022-23. And also approve and ratify the internship during 6th semester.***

12) ***To approve and ratify question paper blue print which is prepared based on bloom's taxonomy, model question papers for 75 external marks and 25 internal marks for core courses.***

13) ***To approve and ratify blue print which is prepared based on bloom's taxonomy and the model question papers for 50 external marks for life skill and skill development courses.***

14) *To approve and ratify list of external examiners.*

15) *To approve suggestions for innovative teaching based on pedagogy and evaluation techniques.*

16) *To approve suggestions for students' seminars, workshops and student- centered activities.*

17) *To approve suggestions for research and extension activities or start-up.*

18) *To encourage students to take up independent research projects at their level by providing facilities.*

19) *To adopt NAAC norms by introducing quality circles among student communities.*

20) *To develop infrastructure facilities,* ***lab facilities*** *in the department and implement guidelines of the academic council.*

21) *To take up ICT mode of teaching and evolve techniques that are easily understood by the students and conduct remedial coaching to the below average students.*

22) *To encourage students to join JKC to equip with communication skills and improve their personality development.*

23) ***To encourage students to participate in the community development activities such as Haritha Krishna Eco Club, NCC and NSS.***

Signatures of the members

MEMBER	NAME & DESIGNATION	SIGNATURE
Head of the Department (Chairman)	Dr. A V RAMESH	
Faculty Members	1. Dr. Ch. S. Anuradha 2. Dr. M. Gopi 3. Smt. D. S. L. Prasanna 4. Sri. K. Nageswara Rao 5. Dr. N. Sankara Rao 6. Sri. T. Appa Rao 7. Dr. G. Lakshmana Rao 8. Sri. Ch. V. SaiKrishna 9. Sri. Y. Venkatesh 10.Dr. B. Sudhamsa Prabhakar	
Subject Expert (University Nominee)	Sri. R. Venkateswara Rao Lecturer in Chemistry GDC, Srikakulam (men)	
Subject Experts (from outside the parent university)	Sri D Adi Narayana Lecturer in Chemistry GDC, Srikakulam (men)	
	Sri S Dilleswara Rao Lecturer in Chemistry,GDC, Tuni	
Member from Industry	Sri I. Bhaskara Reddy, Plant Head, Admiron Life Sciences, Visakhapatnam.	
Member from Alumni	Dr.Sathish Mohan Botsa, Research Scientist B, NCAOR, Goa	
Coordinator, IQAC	Dr. Ch. Lalitha, Lecturer in Micro Biology	
Coordinator, Academic Council	Dr. P. Latha, Lecturer in Physics	
Chairperson, Academic Council	Dr. I. Vijaya Babu Principal	

DR. V. S. KRISHNA GOVT. DEGREE COLLEGE (AUTONOMOUS), VISAKHAPATNAM

REVISED SYLLABUS OF B. Sc. INDUSTRIAL CHEMISTRY

UNDER CBCS FRAMEWORK WITH EFFECT FROM 2022-2023

Programme: B. Sc. with Industrial Chemistry as one of the Core Subjects.

Discipline: Industrial Chemistry

Structure of Industrial Chemistry

YEAR	SEMESTER	COURSE	COURSE CODE	TITLE	MARKS	CREDITS
I	I	I		Material & Energy balances and Utilities in Chemical Industry	100	04
				Practical-I	50	01
	II	II		Inorganic Materials	100	04
				Practical-II	50	01
II	III	III		Cosmetics, Fermentation, Food additives, Sugar and Industrial Pollution	100	04
				Practical-III	50	01
	IV	IV		Dyes, Drugs and Pharmaceuticals, Leather, Paper and Industrial waste management	100	04
				Practical-IV	50	01
	IV	V		Polymers and Instrumental methods of analysis	100	04
				Practical-V	50	01

Structure of Skill Enhancement Courses (SECs) for Semester V/ VI, from 2022-23

(To choose one pair from the three alternate pairs of SECs)

Code	Course NO.	Name of Course	Th. Hrs./ Week	I E Marks	E E Marks	Credits	Prac. Hrs. /Wk.	Marks	Credits
	6A	Unit Processes in Organic Synthesis – I	4	25	75	4	2	50	1
	7A	Unit Processes in Organic Synthesis – II	4	25	75	4	2	50	1
		Or							
	6B	Electro Industrial Chemistry	4	25	75	4	2	50	1
	7B	Corrosion and Its Prevention	4	25	75	4	2	50	1
		Or							
	6C	Medicinal Chemistry	4	25	75	4	2	50	1
	7C	Pesticides and Green Chemistry	4	25	75	4	2	50	1

Note-1: For Semester–V, for the domain subject Industrial Chemistry, any one of the three pairs of SECs shall be chosen as courses 6 and 7, i.e., 6A&7A or 6B&7B or 6C&7C. The pair shall not be broken (ABC allotment is random, not on any priority basis).

Note-2: One of the main objectives of Skill Enhancement Courses (SEC) is to inculcate skills related to the domain subject in students. The syllabus of SEC will be partially skill oriented. Hence, teachers shall also impart practical training to students on the skills embedded in syllabus citing related real field situations.

ANNEXURE - II CBCS CURRICULAR FRAMEWORK (2020 - 21 ONWARDS) - BACHELOR OF SCIENCES

Subjects	SEM I		SEM II		SEM III		SEM IV		SEM V		SEM VI		
	Hrs/W	Credits	Hrs/W	Credits	Hrs/W	Credits	Hrs/W	Credits	Hrs/W	Credits	Hrs/W	Credits	
Languages													
English	4	3	4	3	4	3							
Language (II/T/S)	4	3	4	3	4	3							
Life Skill Courses	2	2	2	2	2+2	2+2							
Skill Development Courses	2	2	2+2	2+2	2	2							
Major 1 Core 1,2,3,& 4	4+2	4+1	4+2	4+1	4+2	4+1	4+2	4+1					
Major 2 Core 1,2,3,& 4	4+2	4+1	4+2	4+1	4+2	4+1	4+2	4+1			THIRD PHASE of APPRENTICESHIP Entire 5th / 6th Semester		FIRST and SECOND PHASES (2 spells) of APPRENTICESHIP between 1st and 2nd year and between 2nd and 3rd year (two summer vacations).
Major 3 Core 1,2,3,& 4	4+2	4+1	4+2	4+1	4+2	4+1	4+2	4+1					
Major 1 Core 5							4+2	4+1					
Major 2 Core 5							4+2	4+1					
Major 3 Core 5							4+2	4+1					
Major 1 Skill Enhancement Courses (6 & 7)									4+2	4+1			
Major 2 Skill Enhancement Courses (6 & 7)									4+2	4+1			
Major 3 Skill Enhancement Courses (6 & 7)									4+2	4+1			
Hrs/W (Academic Credits)	30	25	32	27	32	27	36	30	36	30		12	4 4
Project Work													
Extension Activities (Non NCC/NSS/Sports/Extra Curricular													
Yoga								2					
Extra Credits						1		1					
Hrs/W (Total Credits)	30	25	32	27	32	28	36	33	36	30		12	4 4

SEMESTER-I

Course-I

MATERIAL& ENERGY BALANCES AND UTILITIES IN CHEMICAL INDUSTRY

60hrs (4 hours/week)

Course Outcomes

At the end of the course student will be able to

CO1 Describe the distinction between Atomic weight, Molecular weight and Equivalent Weight.

CO2 Write down the flow diagrams for chemical engineering operations.

CO3 Describe hear capacities of gases and gaseous mixtures.

CO4 Write down water treatment procedures for industrial use.

CO5 Describe the types of boilers.

CO6 Demonstrate knowledge acquired in steam generation.

CO7 Write down compressors and blowers.

CO8 Classify pumps based on their function.

Module-I **12 hours**

Dimensions and units: Basic Chemical Calculations -Atomic weight, molecular weight, equivalent weight, Mole, composition of (i) Liquid mixtures and (ii) gaseous mixtures. Ideal gas law, vapor pressure, Humidity and Saturation.

Module-II **14 hours**

Material Balance without Chemical Reactions: Flow diagram for material balance, simple material balance with or without recycle or by-pass for chemical engineering operations such as distillation, absorption, crystallization, evaporation and extraction.

Material Balance involving chemical reactions: concept of limiting reactant, conversion, yield, selectivity, and liquid phase reaction, gas phase reaction with or without recycle or bypass.

Module-III **10 hours**

Energy Balance: Heat capacity of pure gases and gaseous mixtures at constant pressures, sensible heat changes in liquids, Enthalpy changes during phase transformation: Enthalpy of fusion, Enthalpy of vaporization,

Enthalpy of condensation, Enthalpy of sublimation, Hess's law of constant, Heat Summation and its applications

Module-IV **12 hours**

Utilities in Chemical Industry

a) **Boilers**: Types of boilers and their functioning

b) **Water**: Specifications of industrial use, various water treatments.

c) **Steam**: Generation and use.

d) **Air**: Specification of industrial use, processing of air

Module-V **12 hours**

Fluid flow and Pumps

Fluid flow: Fans, blowers, compressors, vacuum pump, ejectors.

Pumps: Reciprocating pumps, Gear pumps, centrifugal pumps.

Co-curricular activities and Assessment Methods

1. **Assessment of Learning:** Summative assessment- Conduct of semester end exams.
2. **Assessment for Learning:** Formative assessment-Different assessment tools like Minute paper, Muddiest point, Think-Pair-Share, 3-2-1 chart etc.,
3. **Assessment as learning:** Self-assessment-assignments, slip tests etc.,
4. **Quizzes, Guest Lecture, Student seminar, educational tour, field trip etc.**

(D. ADINARAYANA)

Laboratory Course –I **50 Marks**

Practical Paper- I (at the end of semester I) **45 hours (3 hours / week)**

Course Outcomes

At the end of the course student will be able to

CO1 Carry out the Quantitative analysis of calcium in lime stone.

CO2 Determine the hardness of given water sample using EDTA.

CO3 Determine COD and BOD of a given water sample.

CO4 Find out the Percentage of available chlorine present in the bleaching powder.

1. Quantitative analysis of calcium in lime stone by complexometric titration.
2. Hardness of water by EDTA titration.
3. Determination of Chemical Oxygen Demand (COD)
4. Determination of Biological Oxygen Demand (BOD)
5. Percentage of available chlorine in bleaching powder

Reference Books

1. B.I. Bhatt and S.M. Vora: *Stoichiometry*, Tata McGraw-Hill publishing Company Ltd, New Delhi.
2. E. Stocchi: *Industrial Chemistry*, Vol-I, Ellis Horwood Ltd. UK
3. R. M. Felder, R. W. Rousseau: *Elementary Principles of Chemical Processes*, Wiley Publishers, New Delhi.
4. J. A. Kent: Riegel's *Handbook of Industrial Chemistry*, CBS Publishers, New Delhi.
5. P. C. Jain, M. Jain: *Engineering Chemistry,* Dhanpat Rai & Sons, Delhi.
6. R. Gopalan, D. Venkappayya, S. Nagarajan: *Engineering Chemistry,* Vikas Publications, New Delhi.
7. B. K. Sharma: *Engineering Chemistry*, Goel Publishing House, Meerut
8. S. C. Bhatia: *Chemical Process Industries,* Vol. I & II, CBS Publishers, New Delhi.
9. W. L. McCabe and J. C.Smith: *Unit Operations in Chemical Engineering,* Mc-Graw Hill Book Company, New York.
10. O. P. Vermani, A. K. Narula: *Industrial Chemistry,* Galgotia PublicationsPvt. Ltd., New Delhi.
11. Water Analysis Hand Book – NEERI

Guidelines to the Paper Setter: The syllabus I Semester consists of **Material and energy balance and Utilization in Chemical Industry.** The I Semester question paper consists of 2 sections.

PART -A consists of EIGHT short answer questions out of which 5 are to be answered. Each question carries 5 marks.

PART– B: consists of FIVE internal choice essay questions and each question carries 10 marks.

Note:

1. The question paper setters are requested to kindly adhere to the format given in the below table.
2. The question paper setters are also requested to set the questions in the following way:

a. 50% of Questions should be Memory and Understanding based

b. 50% of Questions should be Creativity, Application and Skill based

The examiner is requested to set question paper in such a way that the entire syllabus is reflected in the question paper set by her/him.

Bloom's Taxonomy	Weightage	Module-I	Module-II	Module-III	Module-IV	Module-V
Knowledge/ Remember	30%	1 Essay	1 Essay	1 Short	1 Short	1 Short
Understanding	20%		1 Essay		1 Essay	1 Essay
Application	20%	1 Short		1 Essay	1 Essay	1 Essay
Analysis	15%	1 Short	1 Short			1 Short
Evaluate	15%	1 Essay		1 Essay	1 Short	

B. Sc. Industrial Chemistry
Course-I, Semester-I
BLUE PRINT
(Material and energy balance and Utilization in Chemical Industry)

Sl. No	Module	Name of the chapter	10 Marks	5 Marks
1	Module-I	Material and Energy Balance	2	1
2	Module-II	Material Balance without Chemical Reactions, Material Balance involving chemical reactions	1	1
			1	1
3	Module-III	Energy Balance	2	2
4	Module-IV	Utilities in Chemical Industry	2	2
5	Module-V	Fluid flow, Pumps	2	1

MODEL PAPER

SEMESTER-I

INDUSTRIAL CHEMISTRY Course-I: MATERIAL & ENERGY BALANCES AND UTILITIES IN CHEMICAL INDUSTRY

Time: 3 hours Maximum Marks: 75

PART- A 5 X 5 = 25 Marks

Answer any **FIVE** of the following questions. Each question carries **FIVE** marks.

1. How the equivalent weights of different compounds are calculated. Explain.
2. Explain in brief, the concept of limiting reagent.
3. Explain the flow diagram for material balance without recycle for crystallization
4. Write a note on sensible heats in liquids.
5. How enthalpy changes of gas mixtures are calculated. Explain.
6. Write a note on processing of air.
7. Describe in brief steam generation procedures.
8. Explain briefly about blowers.

PART- B 5 X 10 = 50 Marks

Answer **ALL** the questions. Each carries **TEN** marks

9. (A) Explain with examples how v/v, w/v and w/w of liquid mixtures is calculated.

(Or)

(b) Write notes on i) Humidity and ii) Saturation

10. (A) Explain the flow diagram for material balance with recycle for distillation.

(Or)

(b) Explain the flow diagram for material balance with and without recycle for Evaporation.

11. (A) Define heat capacity and explain in detail about heat capacity of pure gases at constant Pressure.

(Or)

(b)Explain in detail about heat capacity of mixture of gases at constant pressure.

12. (A) Describe in detail about various water treatment procedures.

(Or)

(b) Write an assay on different types of boilers and their functioning.

13. (a) Explain in detail about i) compressors and ii) ejectors.

(Or)

(B) Explain in detail about i) Reciprocating pumps and ii) centrifugal pumps.

SEMESTER-II

Course-II

INORGANIC MATERIALS 60hrs (4 hours/week)

Course Outcomes

At the end of the course student will be able to

CO1 Describe the composition of different types of glasses.

CO2 Write down different types of ceramics and their uses.

CO3 Describe the steps involved in the manufacturing of cement

CO4 Write down manufacturing of different fertilizers

CO5 Describe the classification of alloys

CO6 Demonstrate the manufacture of steel.

CO7 Describe the differences between paints and pigments

CO8 Write down about different types of paints

Module-I **12 Hours**

Silicate Industries-1

Glass: Silicates Introduction, structure, types- orthosilicates, pyrosilicates, chain silicates, cyclic silicates, sheet silicates, on-silicates types. Glassy state and its properties, Manufacture and processing of glass. Composition and properties of the following types of glasses: Soda lime glass, lead glass, armored glass, safety glass, borosilicate glass, fluorosilicate, coloured glass, photosensitive glass.

Module-II **14 Hours**

Silicate Industries-2

1. Ceramics: Important clays and feldspar. Ceramics-types, uses and manufacture. High technology ceramics and their applications.

2. Cements: Classification of cement, ingredients and their role, Manufacture of cement and the setting process, quick setting cements.

Module-III **10 Hours**

Fertilizers

Different types of fertilizers. Manufacture of the following fertilizers: Urea, Ammonium nitrate, Calcium ammonium nitrate, Ammonium phosphates; Polyphosphate, Super phosphate, Compound and mixed fertilizers, Potassium Chloride, Potassium sulphate.

Module-IV **10 Hours**

Alloys

Classification of alloys, Ferrous and Non-Ferrous alloys, Specific properties of elements in alloys. Manufacture of Steel (removal of silicon, decarbonization, demagnetization, desulphurization, dephosphorisation) and surface treatment (argon treatment, heat treatment, nitriding, carburizing). Composition and properties of different types of steels.

Module-V **14 Hours**

Surface Coatings

Objectives of coatings surfaces, preliminary treatment of surface, classification of surface coatings. Paints and pigments-formulation, composition and related properties. Oil paint, modified oils, Pigments, toners and lake pigments, fillers, thinners, enamels, emulsifying agents. Special paints (Heat retardant, Fire retardant, Eco-friendly paint, Plastic paint), Dyes, Wax polishing, Water and Oil paints, additives, Metallic coatings (electrolytic and electrolysis), metal spraying and anodizing.

Co-curricular activities and Assessment Methods

1. **Assessment of Learning:** Summative assessment- Conduct of semester end exams.
2. **Assessment for Learning:** Formative assessment-Different assessment tools like Minute paper, Muddiest point, Think-Pair-Share, 3-2-1 chart etc.,
3. **Assessment as learning:** Self-assessment-assignments, slip tests etc.,
4. **Quizzes, Guest Lecture, Student seminar, educational tour, field trip etc.**

Laboratory Course –II

50 Marks

Practical Paper- II (at the end of semester II) 45 hours (3 hours/week)

Course Outcomes

At the end of the course student will be able to

CO1 Determine the free acidity in a given ammonium sulphate fertilizer

CO2 Estimate calcium present in Calcium ammonium nitrate fertilizer.

CO3 Carry out the analysis of cement

CO4 Estimate phosphoric acid in superphosphate fertilizer.

1. Determination of free acidity in ammonium sulphate fertilizer.
2. Estimation of Calcium in Calcium ammonium nitrate fertilizer.
3. Estimation of phosphoric acid in superphosphate fertilizer.
4. Analysis of Cement.

Reference Books

1. E. Stocchi: *Industrial Chemistry*, Vol-I, Ellis Horwood Ltd. UK
2. W. D. Kingery, H. K. Bowen, D. R. Uhlmann: *Introduction to Ceramics,* Wiley Publishers, New Delhi.
3. J. A. Kent: Riegel's *Handbook of Industrial Chemistry*, CBS Publishers, New Delhi.
4. P. C. Jain, M. Jain: *Engineering Chemistry,* Dhanpat Rai & Sons, Delhi.
5. R. Gopalan, D. Venkappayya, S. Nagarajan: *Engineering Chemistry,* VikasPublications, New Delhi.
6. B. K. Sharma: *Engineering Chemistry*, Goel Publishing House, Meerut
7. S. C. Bhatia: *Chemical Process Industries,* Vol. I & II, CBS Publishers, New Delhi.
8. O. P. Vermani, A. K. Narula: *Industrial Chemistry,* Galgotia Publications Pvt. Ltd., New Delhi.

Guidelines to the Paper Setter: The syllabus of II Semester **Inorganic Materials** consists of 2 sections.

PART -A consists of eight short answer questions out of which 5 are to be answered. Each question carries 5 marks.

PART– B: consists of FIVE internal choice essay questions and each question carries 10 marks.

Note:

1. The question paper setters are requested to kindly adhere to the format given in the below table.
2. The question paper setters are also requested to set the questions in the following way:

a. 50% of Questions should be Memory and Understanding based

b. 50% of Questions should be Creativity, Application and Skill based

The examiner is requested to set question paper in such a way that the entire syllabus is reflected in the question paper set by her/him.

Bloom's Taxonomy	Weightage	Module-I	Module-II	Module-III	Module-IV	Module-V
Knowledge/ Remember	30%	1 Essay	1 Essay		1 Short	1 Short
Understanding	20%		1 Essay	1 Short	1 Essay	1 Essay
Application	20%	1 Short	1 Short	1 Essay	1 Essay	1 Essay
Analysis	15%		1 Short			1 Short
Evaluate/create	15%	1 Essay	1 Short	1 Essay		

B. Sc. Industrial Chemistry COURSE-II(Inorganic Materials), Semester-II
BLUE PRINT

Sl. No	Module	Name of the chapter	10 Marks	5Marks
1	Module-I	**Silicate industries-I** Glass	2	1
2	Module-II	**Silicate industries-II** Ceramics & Cements	2	3
3	Module-III	Fertilizers	2	1
4	Module-IV	Alloys	2	1
5	Module-V	Surface coating	2	2

MODEL PAPER

SEMESTER-II

INDUSTRIAL CHEMISTRY Course-II: INORGANIC MATERIALS

Time: 3 hours Maximum Marks: 75

PART- A 5 X 5 = 25 Marks

Answer any **FIVE** of the following questions. Each question carries **FIVE** marks.

1. Write a note on composition and properties of coloured glass.
2. Describe about important clays.
3. Write the applications of High technology ceramics.
4. What are quick setting cements? Explain briefly.
5. How do you distinguish compound fertilizers from mixed fertilizers? Explain briefly.
6. What are ferrous and non-ferrous alloys? Explain briefly.
7. Write a note on 'oil paints'.
8. Describe in brief about water paints.

PART- B 5 X 10 = 50 Marks

Answer **ALL** the questions. Each carries **TEN** marks

9. (a) Explain the different steps involved in the manufacturing of glass.

(Or)

(b) Describe the composition and properties of (i) Borosilicate glass (ii) Lead glass.

10. (a) What are ceramics? Write about different types of ceramics and their properties.

(or)

(b) Describe steps in the manufacturing of Portland cement.

11. (a) Explain about different types of fertilizers.

(Or)

(b)Explain the manufacturing of (i) Urea and (ii) Super Phosphate

12. (a) Write a note on desulphurization and dephosphorisation of steel.

(Or)

(b) Describe the composition and properties of different types of steels.

13. (a) What are metal coatings. Differentiate between electrolytic and electroless coatings.

(Or)

(b) Explain in detail about special paints.

SEMESTER-III

Course-III

Cosmetics, Fermentation, Food additives, Sugar chemistry and Industrial Pollution

60hrs (4 hours/week)

Course Outcomes

At the end of the course student will be able to

CO1 Write down the preparation and uses of important cosmetics.

CO2 Write down the preparation and uses.

CO3 Differentiate the Aerobic and anaerobic fermentation processes.

CO4 Describe the production of chemicals by fermentation process.

CO5 Demonstrate the knowledge gained on Food additives.

CO6 Write down the manufacture of Sugar.

CO7 Write down the manufacture of Sucrose.

CO8 Describe about different types of pollutants.

Module-I **12 Hours**

Cosmetics and Perfumes

A general study including preparation and uses of the following: Hair dye, hairspray, Shampoo, Suntan lotions, face powder, lipsticks, talcum powder, nail enamel, creams (cold, vanishing and shaving creams), antiperspirants and artificial flavors. Essential oils and their importance in cosmetic industries with reference to Eugenol, Geraniol, sandalwood oil, eucalyptus, rose oil, phenylethyl alcohol, Jasmone, Civetone, and Muscone.

Module-II **12 hours**

Fermentation Industries

Aerobic and anaerobic fermentation. Production of (i) Ethyl alcohol and citric acid, (ii) Antibiotics; Penicillin and Streptomycin, (iii) Lysine and Vitamin C.

Module-III **12 hours**

Food additives

A general study of food flavors- Flavoring agents: Vanilla, diacetyl, isoamyl acetate, limonene, ethylpropionate, allyl hexanoate. Colours: Briliant blue FCF, fast green FCF, tertrazine, erythrosine, sunset yellow FCF and preservatives: Sodium carbonate, sodium benzoate, sorbic acid and artificial sweeteners.

Module-IV **10 hours**

Sugar Chemistry

Introduction – Manufacture of sugar from sugarcane. Manufacture and recovery of sugar from molasses, manufacture of sucrose from beet root, testing and Quantitative estimation of sugar. Hu

Module-V **14 hours**

Industrial pollution

Pollutants and their statutory limits

Air Pollution- various pollutants

Water pollution- Organic and Inorganic pollutants

Noise pollution

Co-curricular activities and Assessment Methods

1. **Assessment of Learning:** Summative assessment- Conduct of semester end exams.
2. **Assessment for Learning:** Formative assessment-Different assessment tools like Minute paper, Muddiest point, Think-Pair-Share, 3-2-1 chart etc.,
3. **Assessment as learning:** Self-assessment-assignments, slip tests etc.,
4. **Quizzes, Guest Lecture, Student seminar, educational tour, field trip etc.,**

Laboratory Course –III **50 Marks**

Practical Paper- III (at the end of semester III) 45 hours (3 hours/week)

Course Outcomes

At the end of the course student will be able to

CO1 Carryout the analysis of a given oil and fat.

CO2 Find out the adulterants in turmeric powder, milk and mustard oil.

CO3 Estimate the glucose present in the food sample.

CO4 Prepare Talcum powder, nail polish and face cream.

1. Analysis of oils and fats (iodine value, saponification value, acid value)
2. Testing of turmeric powder, milk and mustard oil for adulterants.
3. Estimation of glucose in food samples.
4. Preparation of talcum powder, nail polish and face cream

Reference Books

1. E. Stocchi: *Industrial Chemistry*, Vol-I, Ellis Horwood Ltd. UK
2. J. A. Kent: Riegel's *Handbook of Industrial Chemistry*, CBS Publishers, New Delhi.
3. P. C. Jain, M. Jain: *Engineering Chemistry,* Dhanpat Rai & Sons, Delhi.
4. Practical's and Calculation in Engineering Chemistry – S.S. Dara
5. A. K. De, *Environmental Chemistry*: New Age International Pvt, Ltd, New Delhi.
6. S.P. MAHAJAN: *Pollution control in process industries,* Tata McGraw-Hillpublishing Company limited, New Delhi.
7. C. k. Varshney: *Water Pollution and Management*, Wiley Eastern Limited, Chennai

Guidelines to the Paper Setter: The syllabus of III Semester consists of **Cosmetics, Fermentation, Paints & Pigments, Sugar & Industrial pollution**. The III Semester question paper consists of 2 sections.

PART -A consists of EIGHT short answer questions out of which 5 are to be answered.

Each question carries 5 marks.

PART– B: consists of FIVE internal choice essay questions and each question carries 10 marks.

Note:

1. The question paper setters are requested to kindly adhere to the format given in the below table.

2. The question paper setters are also requested to set the questions in the following way:

a. 50% of Questions should be Memory and Understanding based

b. 50% of Questions should be Creativity, Application and Skill based

The examiner is requested to set question paper in such a way that the entire syllabus is reflected in the question paper set by her/him.

Bloom's Taxonomy	Weightage	Module-I	Module-II	Module-III	Module-IV	Module-V
Knowledge/ Remember	30%	1 Essay	1 Essay	1 Short	1 Short	1 Short
Understanding	20%		1 Essay	1 Short	1 Essay	1 Essay
Application	20%	1 Short	1 Short	1 Essay	1 Essay	1 Essay
Analysis	15%	! Short		1 Short		
Evaluate	15%	1 Essay		1 Essay		1 Short

B. Sc. Industrial Chemistry, COURSE-III, Semester-III BLUE PRINT
(Cosmetics, Fermentation, Paints & Pigments, Sugar & Industrial pollution)

Sl. No	Module	Name of the chapter	10 Marks	5 Marks
1	Module-I	Cosmetics and Perfumes	2	2
2	Module-II	Fermentation Industries	2	1
3	Module-III	Paints and Pigments	2	3
4	Module-IV	Sugar Chemistry	2	1
5	Module-V	Industrial Pollution	2	1

MODEL PAPER

SEMESTER-III

INDUSTRIAL CHEMISTRY Course-III: Cosmetics, Fermentation, Food additives, Sugar chemistry and Industrial Pollution

Time: 3 hours Maximum Marks: 75

PART- A 5 X 5 = 25 Marks

Answer any **FIVE** of the following questions. Each question carries **FIVE** marks.

1. Write the uses of artificial flavors.
2. Describe the importance of rose oil.
3. Differentiate between aerobic and anaerobic fermentation.
4. Write a note on flavoring agent 'Vanilla'.
5. What are artificial sweeteners? Explain briefly.
6. Explain in brief the use of sodium carbonate as food preservative.
7. Describe in brief how sucrose is estimated.
8. Write a note on noise pollution.

PART- B 5 X 10 = 50 Marks

Answer **ALL** the questions. Each carries **TEN** marks

9. (a) Write the preparation and uses of Sun-tan lotions and vanishing creams.

(Or)

(b) What are essential oils? Describe the importance of Jasmone and Muscone.

10. (a) Explain the production of ethyl alcohol by fermentation process.

(Or)

(b) Describe the production of Penicillin by fermentation process.

11. (a) Write a note on the following food coloursi) Briliant blue FCF and ii) Erythrosine

(Or)

(b) Write a note on the following food preservatives i) sodium benzoate and ii) sorbic acid.

12. (a) Explain the manufacture of sugar from molasses.

(Or)

(b)Explain the manufacture of sucrose from beat root.

13. (a) Write a note on organic pollutants in water.

(Or)

(b) Explain point and nonpoint sources of air pollution. What are the primary and Secondary air pollutants? Give examples.

SEMESTER-IV

Course-IV

Dyes, Drugs, Pharmaceuticals, Leather chemistry, Paper industry and Industrial waste management

60hrs (4 hours/week)

Course Outcomes

At the end of the course student will be able to

CO1 Describe the classification of dyes.

CO2 Write down the industrial preparation of Common dyes.

CO3 Describe the manufacture of leather.

CO4 Write down the manufacture of pulp.

CO5 Demonstrate the preparation of paper.

CO6 Gain knowledge about the synthesis of important drugs.

CO7 Demonstrate the steps involved in waste management.

CO8 Describe the different water purification methods.

Module-I **12 hours**

Dyes

Introduction, Classification with special reference to textile and edible dyes and fabric brighteners. Types of all fabric dyes used in textile industry. Industrial preparation and uses of methyl orange, malachite green, indigo, Bismarck brown, alizarin.

Module -II **08 hours**

Leather Chemistry- Introduction, Manufacture of Leather and Preparation of hides for tanning, vegetable, chrome and oil tanning.

Module-III

Paper Industry **10 hours**

Pulp and Paper- Introduction, Manufacture of pulp, sulphate or Kraft pulp, soda pulp, sulphite pulp, rag pulp, beating, refining, filling, sizing and coloring of pulp, manufacture of paper.

Module-IV

15 hours

Drugs and Pharmaceuticals

Synthesis of the representative drugs of the following classes: analgesics agents, antipyretic agents, anti-inflammatory agents (Aspirin, paracetamol, ibuprofen); antibiotics (Chloramphenicol); antibacterial and antifungal agents (Sulphonamides; Sulfamethoxazole and Sulphacetamide); anti-viral agents (Acyclovir), Central Nervous System agents Phenobarbital, Diazepam),Cardiovascular (Glyceryl trinitrate), antilaprosy (Dapsone), HIVAIDS related drug (AZT- Zidovudine).

Module-V

15 hours

Industrial Waste Management

Waste water treatment - primary, secondary& tertiary treatment

Solid Waste Management Pyramid – Key Technologies for SWM (collection, handling, transformation, landfills, incinerators, composting)

Water treatment and purification (reverse osmosis, electro dialysis, ion exchange)

Co-curricular activities and Assessment Methods

1. **Assessment of Learning:** Summative assessment- Conduct of semester end exams.
2. **Assessment for Learning:** Formative assessment-Different assessment tools like Minute paper, Muddiest point, Think-Pair-Share, 3-2-1 chart etc.,
3. **Assessment as learning:** Self-assessment-assignments, slip tests etc.,
4. **Quizzes, Guest Lecture, Student seminar, educational tour, field trip etc.**

Laboratory Course –IV **50 Marks**

Practical Paper- IV (at the end of semester IV) 45 hours (3 hours/week)

Course Outcomes

At the end of the course student will be able to

CO1 Prepare Methyl orange

CO2 Synthesize important compounds

1. Preparation of Methyl Orange.
2. Synthesis of common industrial compounds involving two step reactions, e.g. 4- bromoaniline, 3-nitroaniline, sulphanilamide, 4-amino benzoic acid, 4-nitro benzoic acid, nitrohalobenzenes, oil of winter green) **(any three)**

Reference Books

1. E. Stocchi: *Industrial Chemistry*, Vol-I, Ellis Horwood Ltd. UK
2. J. A. Kent: Riegel's *Handbook of Industrial Chemistry*, CBS Publishers, New Delhi.
3. P. C. Jain, M. Jain: *Engineering Chemistry,* Dhanpat Rai & Sons, Delhi.
4. Practicals and Calculation in Engineering Chemistry – S.S. Dara
5. S.P. Mahajan: *Pollution control in process industries,* Tata McGraw-Hillpublishing Company limited, New Delhi.
6. G.L. Patrick: *Introduction to Medicinal Chemistry, Oxford University* Press, UK.
7. Hakishan, V.K. Kapoor: *Medicinal and Pharmaceutical Chemistry,* Vallabh Prakashan, Pitampura, New Delhi.
8. William O. Foye, Thomas L., Lemke, David A. William: *Principles of Medicinal Chemistry*, B.I. Waverly Pvt Ltd. New Delhi.
9. Jayashree Ghosh: *Text Book of Pharmaceutical Chemistry*, 2nd edition, S.Chand& Company, New Delhi

Guidelines to the Paper Setter:

The syllabus of IV Semester course-IV consists of Dyes, **Leather, Paper, Corrosion and Industrial waste management**. The IV Semester Course-IV question paper consists of 2 sections.

PART -A consists of EIGHT short answer questions out of which 5 are to be answered. Each question carries 5 marks.

PART– B: consists of FIVE internal choice essay questions and each question carries 10 marks.

Note:

1. The question paper setters are requested to kindly adhere to the format given in the below table.
2. The question paper setters are also requested to set the questions in the following way:

a. 50% of Questions should be Memory and Understanding based

b. 50% of Questions should be Creativity, Application and Skill based

The examiner is requested to set question paper in such a way that the entire syllabus is reflected in the question paper set by her/him.

Bloom's Taxonomy	Weightage	Module-I	Module-II	Module-III	Module-IV	Module-V
Knowledge / Remember	30%	1 Essay	1 Essay		1 Short	1 Short
Understanding	20%	1 Short	1 Essay	1 Short	1 Essay	1 Essay
Application	20%	1 Short		1 Essay	1 Essay	1 Essay
Analysis	15%		1 Short		1 Short	1 Short
Evaluate	15%	1 Essay		1 Essay		

B. Sc. Industrial Chemistry, Semester - IV, Course-IV
BLUEPRINT
(Dyes, Leather, Paper, Corrosion and Industrial waste management)

Sl. No	Module	Name of the Chapter	10 Marks	5 Marks
1	Module-I	Dyes	2	2
2	Module -II	Leather chemistry	2	1
3	Module -III	Paper industry –Pulp and paper	2	1
4	Module-IV	Corrosion and its control	2	2
5	Module-V	Industrial waste management	2	2

MODEL PAPER
SEMESTER-IV
INDUSTRIAL CHEMISTRY Course-IV: Dyes, Drugs, Pharmaceuticals, Leather chemistry, Paper industry and Industrial waste management

Time: 3 hours Maximum Marks: 75

PART- A 5 X 5 = 25 Marks

Answer any **FIVE** of the following questions. Each question carries **FIVE** marks.

1. Write the preparation and uses of alizarin.
2. What are fabric brighteners? Explain in brief.
3. Explain in brief preparation of hide for tanning.
4. What is rag pulp? Explain briefly.
5. Write the structure and uses of Acyclovir.
6. Write a note on Zidovudine.
7. Define the term 'Incineration'. Explain in brief.
8. Explain in brief how ion exchange method is used for the purification of water.

PART- B 5 X 10 = 50 Marks

Answer **ALL** the questions. Each carries **TEN** marks

9. (a) Describe the classification of textile dyes.

(or)

(b)Explain the industrial preparation and uses of methyl orange and malachite green.

10. (a) Describe in detail important steps involved in the manufacture of Leather.

(Or)

(b) Describe the vegetable tanning process in detail.

11. (a) Explain the Kraft process for the production of pulp.

(Or)

(b) Explain with a neat diagram several stages involved in the paper manufacturing Process.

12. (a) Write the synthesis of paracetamol and aspirin.

(Or)

(b)Write the synthesis of Phenobarbital and Dapsone.

13. (A) Explain in detail the different stages involved in the waste water treatment.

(Or)

(b) What is Reverse osmosis? Explain how it is used for the purification of water.

SEMESTER-IV

Course-V

Polymers and Instrumental methods of analysis

60hrs (4 hours/week)

Course Outcomes

At the end of the course student will be able to

CO1 Describe the classification of polymers.

CO2 Write down the manufacture of commonly used polymers.

CO3 Describe about Specialty polymers.

CO4 Write down about boron containing, phosphorus containing and, silicon containing Polymers.

CO5 Describe about important electro analytical techniques.

CO6 Describe the thermo analytical techniques.

CO7 Write about the principle and applications of flame photometry.

CO8 Write about the principle and applications of atomic absorption spectroscopy.

Module-I **15 hours**

Organic Polymers-1

Basic definitions, degree of polymerization, classification of polymers- Natural and Synthetic polymers, Organic and Inorganic polymers, Thermoplastic and Thermosetting polymers, Plastics, Elastomers, Fibers and Resins, Linear, Branched and Cross Linked polymers, Addition polymers and Condensation Polymers, mechanism of polymerization-Free radical, ionic and Zeigler-Natta polymerization. Industrial manufacturing and applications of following polymers, Polystyrene, Polyacrylonitrile, Polymethacrylate, Polymethyl- methacrylate, Polyethene, poly vinyl chloride, PTFE, Polyesters, Polyurethanes, Nylon (6 and 66).

Module-II **15 hours**

Organic Polymers-2

Specialty Polymers (Electro-luminescent, Biopolymers, Conducting polymers), Rubbers (synthetic and natural) and their processing, Elastomers, Cellulosics, Natural and Synthetic fibers. Comparison Of natural and synthetic polymers. Polymer Processing: Moulding, compounding, blending. Polymer designing: packaging, certification and process evaluation.

Module-III **8 hours**

Inorganic Polymers: Classification, preparation, properties and uses of boron containing polymers, phosphorus containing polymers, silicon containing polymers- Silicones (fluid, elastomers and resins) and Sulphur containing polymers(SN)x.

Module-IV **16 hours**

Instrumental methods of analysis

Electro analytical techniques- Potentiometry, voltammetry, polarography and Colorimetry-principle, instrumentation and applications.

Thermo analytical techniques- Thermal gravimetric analysis (TGA), differential thermal analysis (DTA), differential scanning calorimetry (DSC) – principle and applications.

Module-V **06 hours**

Instrumental methods of analysis

Atomic spectroscopy: Atomic spectroscopy introduction, Atomic spectrum, Rydberg equation, types of spectroscopy and types of atomic spectroscopy.

Flame photometry, Atomic absorption spectroscopy-Principles and their applications.

Co-curricular activities and Assessment Methods

1. **Assessment of Learning:** Summative assessment- Conduct of semester end exams.
2. **Assessment for Learning:** Formative assessment-Different assessment tools like Minute paper, Muddiest point, Think-Pair-Share, 3-2-1 chart etc.,
3. **Assessment as learning:** Self-assessment-assignments, slip tests etc.,
4. **Quizzes, Guest Lecture, Student seminar, educational tour, field trip etc.**

Laboratory Course –V **50 Marks**

Practical Paper- V (at the end of semester V) 45 hours (3 hours/week)

Course Outcomes

At the end of the course student will be able to

CO1 Carry out the extraction of natural coloring and flavoring agents

CO2 Prepare Nylon 6, 6

CO3 Determine Na^+ and K^+ using Flame Photometry.

CO4 Verify Beer Lambert's by using spectrophotometry

1. Extraction of natural coloring and flavoring agents from flowers and fruits (extraction of Any three coloring and flavoring agents).
2. Preparation of nylon 6, 6.
3. Determination of concentration of Na^+ and K^+ using Flame Photometry.
4. Verification of Beer Lambert's by using spectrophotometry.

Reference Books

1. K.J. Saunders: *Organic Polymer Chemistry*, Chapmann & Hall, London.
2. P.J. Flory: *Principles of Polymer Chemistry*, Cornell University Press, NY.
3. G. Odian: *Principles of Polymerization*, John Wiley & Sons Inc, NY.
4. James E. Mark, HaryAllcock, Robert West, *Inorganic Polymers*, PrenticeHall Englewood.
5. Polymer science V. R. Gowariker, N. V. Viswanathan and Jayadev Sreedhar, Halsted Press (John Wiley & Sons), New York, 1986.
6. H.H. Willard, L.L. Merrit, J.A. Dean, F. A. Settle*: Instrumental Methods of Chemical Analysis*, Wadsworth Publishing Company, California.
7. G. D. Christian: *Analytical Chemistry*, John Wiley, NY.
8. S.M. Khopkar: *Basic Concepts of Analytical Chemistry*, Wiley Eastern Ltd, New Delhi.
9. D.A. Skoog, D.M.West, F.J. Holler: *Fundamentals of Analytical Chemistry*, Cengage Learning.

Guidelines to the Paper Setter:

The V Semester, course-V "Polymers **and Instrumental methods of analysis"** question paper consists of 2 sections.

PART -A consists of EIGHT short answer questions out of which 5 are to be answered.

Each question carries 5 marks.

PART– B: consists of FIVE internal choice essay questions and each question carries 10 marks.

Note:

1. The question paper setters are requested to kindly adhere to the format given in the below table.
2. The question paper setters are also requested to set the questions in the following way:

a. 50% of Questions should be Memory and Understanding based

b. 50% of Questions should be Creativity, Application and Skill based

The examiner is requested to set question in such a way that the entire syllabus is reflected in the question paper set by her/him.

Bloom's Taxonomy	**Weightage**	**Module-I**	**Module-II**	**Module-III**	**Module-IV**	**Module-V**
Knowledge/ Remember	30%	1 Essay	1 Essay		1 Short	1 Short
Understanding	20%	1 Short	1 Essay	1 Short		1 Essay
Application	20%	2 Short		1 Essay	1 Essay	1 Essay
Analysis	15%	1 Short			1 Essay	
Evaluate	15%	1 Essay	1 Short	1 Essay		

BLUEPRINT FOR
B. Sc. Industrial Chemistry, Semester-V, COURSE-V
(Polymers and Instrumental methods of analysis)

Sl. No	**Module**	**Name of the Chapter**	**10 Marks**	**5 Marks**
1	Module-I	**Organic Polymers-1**	2	3
2	Module-II	**Organic Polymers-2**	2	2
3	Module-III	**Inorganic Polymers**	2	1
4	Module-IV	**Instrumental methods of analysis**	2	1
5	Module-V	**Instrumental methods of analysis**	2	1

MODEL PAPER

SEMESTER-IV

INDUSTRIAL CHEMISTRY Course-V: Polymers and Instrumental methods of analysis

Time: 3 hours Maximum Marks: 75

PART- A 5 X 5 = 25 Marks

Answer any **FIVE** of the following questions. Each question carries **FIVE** marks.

1. Describe in brief classification of polymers.
2. Write the preparation and properties of PVC.
3. Explain in brief the Zeigler-Natta polymerisation.
4. What is PTFE? Write the preparation and properties of PTFE.
5. Write a note conducting polymers.
6. Explain in brief about the preparation and properties of Sulphur containing polymers.
7. Write the principle and applications of Polarography.
8. What is DSC? Write its applications.

PART- B 5 X 10 = 50 Marks

Answer **ALL** the questions. Each carries **TEN** marks

9. (a) Explain the preparation and properties of i) polystyrene and ii) Nylon 6, 6.

(Or)

(b)What is free radical polymerization? Explain in detail the mechanism.

10. (a) Describe about natural and synthetic rubbers.

(Or)

(b) Write a note on i) Cellulosics and ii) Biopolymers

11. (a) Explain the preparation, properties and applications of Boron containing polymers,

(Or)

(b) Explain the preparation, properties and applications of silicones.

12. (a) Explain the principle, instrumentation and applications of potentiometry.

(Or)

(b)Describe the principle and applications of Thermal gravimetric analysis (TGA).

13. (a) Explain the principle and applications of Flame photometry.

(Or)

(b) Explain the principle and applications of Atomic absorption spectroscopy

Skill Enhancement Course (SEC) Semester V

Semester–V

Industrial chemistry 6A: Unit Processes in Organic Synthesis – I

I. Learning Outcomes:

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

1. Learn about different types of unit processes in chemical industries.
2. Apply the knowledge on newer techniques in industrially important products with the help of various unit processes.
3. Understand unit processes and flow sheet for manufacturing of industrial products through halogenation, nitration, Sulphonation, hydrogenation and oxidation reactions.
4. Expertise in operating procedures, hazard analysis, and safe work practices.

II. Syllabus :(Total Hours: 90 including Teaching, Lab, Field Skills Training, Unit tests etc.)

Module-I

Halogenation **12h**

Halogenating agents, thermodynamics, mechanisms and kinetics of halogenation reactions, chlorination in the presence of a catalyst, photo halogenation. Industrial manufacturing process for Chloral, Benzene Hexachloride (BHC), and DDT.

Module-II

Nitration **12h**

Nitrating agents, aromatic nitration, kinetics and mechanism of aromatic nitration, Gas – phase nitration of paraffinic hydrocarbons, nitrate esters, N-nitro compounds, process equipment for technical nitrations. Industrial processes for the manufacture of nitrobenzene.

Module – III

Sulphonation **12h**

Sulphonating agents and their principal applications, chemical and physical factors in Sulphonation, kinetics and mechanism, desulphonation, workup procedures, industrial equipment and technique, transition from batch to continuous processing. Industrial process for manufacture of benzene sulfonic acid by continuous partial-pressure distillation method.

Module – IV

Hydrogenation **12h**

Catalytic hydrogenation reactions, hydrogenolysis reactions, general principles concerning hydrogenation catalysts, general classification of hydrogenation catalysts, hydrogenation equipment, Industrial processes for hydrogenation of oils and synthesis of methanol.

Module – V

Oxidation **12h**

Types of oxidative reactions, oxidizing agents, liquid phase oxidation of aniline, furfural with different oxidizing agents. Commercial methods for oxidation of acetaldehyde, cyclohexane. Vapour phase oxidation of naphthalene.

III. Recommended Books:

1. P. H. Groggins: Unit Processes in Organic Synthesis (MGH)
2. F. A. Henglein: Chemical Technology (Pergamon)
3. M. G. Rao and M. Sittings: Outlines of Chemical Technology (EWP)
4. Clausen, Mattson: Principles of Industrial Chemistry
5. H A. Lowenheim and M. K. Moran: Industrial Chemicals
6. Kirk and Othmer: Encyclopedia of Chemical technology.
7. Kent, Riegel's Industrial Chemistry (N-R).
8. S. D. Shukla and G. N. Pandey: A Textbook of Chemical Technology, Vol-II
9. J. K Stille: Industrial Organic Chemistry (P.I I.).

Skill Enhancement Course (SEC) Semester V

Industrial chemistry Course – 6A: Unit Processes in Organic Synthesis – I
(Practical Syllabus)

IV. Laboratory-Skill Outcomes:

At the end of the course students will be able to

1. Understand the apparatus handling technique.
2. Demonstrate a clear understanding of the reactions of key organic functional groups.
3. Perform organic preparations.
4. Acquire skill for workup procedures.
5. Understand the concept of purification of organic compounds.

V. Practical (Laboratory) Syllabus:

Preparations (One experiment from each group to be demonstrated) **30h**

a. Preparation of p-bromoacetanilide
b. Preparation of 2, 4, 6- tribromophenol
c. Nitration of acetanilide
d. Nitration of nitrobenzene.
e. Toluene-p-sulphonic Acid/ Phenyl Toluene–p–sulphonate
f. Preparation of Sulphanilamide.
g. Hydrogenation of Nitrobenzene.
h. Preparation of Benzil.
i. Preparation of benzoic acid from benzyl chloride.
j. Synthesize and Characterize Methyl Orange

VI. Recommended books/References:

1. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009).
2. Furniss, B.S., Hannaford, A.J., Smith, P.W.G. & Tatchell, A.R. Practical Organic Chemistry, 5th Ed. Pearson (2012).
3. Ahluwalia, V.K. & Aggarwal, R. Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, University Press (2000).
4. Ahluwalia, V.K. & Dhingra, S. Comprehensive Practical Organic Chemistry: Qualitative Analysis, University Press (2000).

VII. Co-Curricular Activities:

a) **Mandatory**: (Training of students by teacher on field related skills: 15 hours)

1. **For Teacher**: Training of students by the teacher in the classroom or in the laboratory for not less than 15 hours on field related quantitative techniques for drug synthesis.
2. **For Student**: Individual visit to any one of the local field agencies, research laboratories in universities/research organizations/private sector culminating writing and submission of a hand-written fieldwork/project work Report not exceeding 10 pages in the given format.
3. Max marks for fieldwork/project work Report: 05.
4. Suggested Format for fieldwork/project work: Title page, student details, index page, details of places visited, observations, findings and acknowledgements.
5. Unit tests (IE).

b) **Suggested Co-Curricular Activities**:

1. Training of students by related industrial experts.
2. Visits to research organizations and laboratories.
3. Invited lectures and presentations on related topics by field / industrial experts.
4. Assignments.
5. Seminars, workshops, group discussions, quiz, debates etc. (on related topics).
6. Preparation of videos on tools, techniques and applications of industrial processes.

Guidelines to the Paper Setter: The V Semester, **Industrial chemistry-6A Processes in Organic Synthesis – I** question paper consists of 2 sections.

PART -A consists of EIGHT short answer questions out of which 5 are to be answered. Each question carries 5 marks.

PART– B: consists of FIVE internal choice essay questions and each question carries 10 marks.

Note:

1. The question paper setters are requested to kindly adhere to the format given in the below table.
2. The question paper setters are also requested to set the questions in the following way:
   a. 80% of Questions should be Memory and Understanding based
   b. 20% of Questions should be Creativity, Application and Skill based

The examiner is requested to set question paper in such a way that the entire syllabus is reflected in the question paper set by her/him.

Bloom's Taxonomy	Weigh tage	Module-I	Module-II	Module-III	Module-IV	Module-V
Knowledge/ Remember	30%	1 Essay	1 Essay	1 Essay	1 Short	1 Short
Understanding	20%	1 Essay	1 Essay	1 Short	1 Essay	1 Essay
Application	20%	1 Short	1 Short	1 Essay	1 Essay	1 Essay
Analysis	15%		1 Short		1 Short	1 Short
Evaluate	15%			1 Short		

B. Sc. Industrial Chemistry
Course-6A, Semester-V
BLUE PRINT
Unit Processes in Organic Synthesis – I

Sl. No	Module	Name of the chapter	10 Marks	5 Marks
1	Module-I	Halogenation	2	1
2	Module-II	Nitration	2	2
3	Module-III	Sulphonation	2	2
4	Module-IV	Hydrogenation	2	2
5	Module-V	Oxidation	2	1

Semester-V Model Paper

Industrial Chemistry 6A: Unit Processes in Organic Synthesis – I

Max.Marks:75 **Time: 3 hrs.**

SECTION - A (5x5=25 Marks)

Answer any five of the following questions. Each answer carries 5 marks.

1. Write short note on photo halogenation.
2. Write about kinetics and mechanism of aromatic nitration.
3. Write short note on desulphonation reaction.
4. Give the composition of butenes obtained from partial hydrogenation of butadiene in 95% alcohol.
5. Write about the general classification of hydrogenation catalysts?
6. Write the products for liquid phase oxidation of furfural with different oxidising agents.
7. Write the products for liquid phase oxidation of aniline with different oxidising agents.
8. Write about Kinetics of Explain vapour phase oxidation of Naphthalene Sulphonation reaction?

SECTION - B (5x10=50 Marks)

Answer all the questions. Each answer carries 10 marks

1. (a) Explain the industrial manufacturing process of chloral and DDT

   Or

   (b) Discuss about the kinetics and mechanism of halogenation reaction

2. (a) Describe the process equipment for technical nitration.

   Or

   (b)Give a detailed account on the industrial process for the manufacture of nitrobenzene

3. (a) Explain industrial manufacturing process of benzene sulfonic acid by continuous partial pressure distillation method.

   Or

   (b) Write about the sulphonating agents, their applications and the factors affecting sulphonation

4. (a) Explain the industrial process for hydrogenation of oils.

   Or

   (b) Describe the industrial process for the synthesis of Methanol

5. (a) Explain vapour phase oxidation of naphthalene.

   Or

   (b) Discuss about the commercial methods for the oxidation of Acetaldehyde

Skill Enhancement Course (SEC) Semester V

Course 7A: **Unit Processes in Organic Synthesis – II**

I. Learning Outcomes:

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

1. Learnt about different types of unit processes in chemical industries.
2. Apply the knowledge on newer techniques in industrially important products with the help of various unit processes.
3. Understand unit processes and flow sheet for manufacturing of industrial products through esterification, hydrolysis, amination and alkylation.
4. Expertise in operating procedures, hazard analysis, and safe work practices.

II. Syllabus :(Total Hours: 90 including Teaching, Lab, Field Skills Training, Unit tests etc.)

Module – I

Esterification **12h**

Esterification of carboxylic acid derivatives, esters by addition to unsaturated systems, esters of inorganic acids, technical preparation of ethyl acetate (batch and continuous) and glyceryl trinitrate.

Module-II

Hydrolysis **12h**

Definition and scope, Hydrolysing agents, Hydrolysis of carbohydrates, esters and nitrogen compounds. Thermodynamics of ethyl acetate hydrolytic reaction. Factors affecting on the rate of hydrolysis. Manufacture of soap, glycerol and fatty acids.

Module – III

Amination by reduction **12h**

Methods of reduction. Iron and acid reduction of nitrobenzene – chemical mechanism and chemical and physical factors. Industrial manufacture of p-phenylenediamine. Reaction conditions for catalytic reduction. Electrolytic reduction and metal – alkali reduction of nitro compounds.

Module – IV

Amination by ammonolysis **12h**

Aminating agents, survey of amination reactions with one example each, physical and chemical factors affecting ammonolysis, catalysts used in amination reactions, kinetics of ammonolysis. Industrial manufacture continuous process of aniline from chlorobenzene.

Module – V

Alkylation **12h**

Types of alkylation, alkylating agents, mechanisms for liquid-phase alkylations of hydrocarbons. Factors affecting on the rate of alkylation, equipment for alkylations, alkylation methods for alkyl aryl detergents and alkylate for the petroleum industry.

III. Recommended Books:

1. P. H. Groggins: Unit Processes in Organic Synthesis (MGH)
2. F. A. Henglein: Chemical Technology (Pergamon)
3. M. G. Rao and M. Sittings: Outlines of Chemical Technology (EWP)
4. Clausen, Mattson: Principles of Industrial Chemistry
5. H A. Lowenheim and M. K. Moran: Industrial Chemicals
6. Kirk and Othmer: Encyclopedia of Chemical technology.
7. Kent, Riegel's Industrial Chemistry (N-R).
8. S. D. Shukla and G. N. Pandey: A Textbook of Chemical Technology, Vol-II
9. J. K Stille: Industrial Organic Chemistry (P.I I.).

Course – 7A: Unit Processes in Organic Synthesis – II (Practical Syllabus)

IV. Laboratory-Skill Outcomes:

At the end of the course students will be able to

1. Understand the apparatus handling technique.
2. Demonstrate a clear understanding of the reactions of key organic functional groups.
3. Perform organic preparations.
4. Acquire skill for workup procedures.
5. Understand the concept of purification of organic compounds.

V. Practical (Laboratory) Syllabus:

Preparations (One experiment from each group to be demonstrated) **30h**

a. Preparation of Phenyl benzoate from phenol.
b. Preparation of benzocaine.
c. Preparation of acetanilide/benzanilide
d. Preparation of benzamide.
e. Hydrolysis of benzamide
f. Hydrolysis of ethyl benzoate/phenyl benzoate
k. Reduction of p-Nitroacetanilide with Iron/acetic acid.
l. Reduction of p-nitrobenzaldehyde by sodium borohydride.
m. Synthesis and Characterization of Flurosene Dye

VI. Recommended books/References:

1. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009).
2. Furniss, B.S., Hannaford, A.J., Smith, P.W.G. & Tatchell, A.R. Practical Organic Chemistry, 5th Ed. Pearson (2012).
3. Ahluwalia, V.K. & Aggarwal, R. Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, University Press (2000).
4. Ahluwalia, V.K. & Dhingra, S. Comprehensive Practical Organic Chemistry: Qualitative Analysis, University Press (2000).

VII. Co-Curricular Activities:

a) **Mandatory**: (Training of students by teacher on field related skills: 15 hours)

1. **For Teacher**: Training of students by the teacher in the classroom or in the laboratory for not less than 15 hours on field related quantitative techniques for drug synthesis.
2. **For Student**: Individual visit to any one of the local field agencies, research laboratories in universities/research organizations/private sector culminating writing and submission of a hand-written fieldwork/project work Report not exceeding 10 pages in the given format.
3. Max marks for fieldwork/project work Report: 05.
4. Suggested Format for fieldwork/project work: Title page, student details, index page, details of places visited, observations, findings and acknowledgements.
5. Unit tests (IE).

b) **Suggested Co-Curricular Activities**:

1. Training of students by related industrial experts.
2. Visits to research organizations and laboratories.
3. Invited lectures and presentations on related topics by field / industrial experts.
4. Assignments.
5. Seminars, workshops, group discussions, quiz, debates etc. (on related topics).
6. Preparation of videos on tools, techniques and applications of industrial processes.

Guidelines to the Paper Setter: The V Semester Industrial Chemistry course 7A- **processes in Organic Synthesis-II** question paper consists of 2 sections.

PART -A consists of EIGHT short answer questions out of which 5 are to be answered. Each question carries 5 marks.

PART– B: consists of FIVE internal choice essay questions and each question carries 10 marks.

Note:

1. The question paper setters are requested to kindly adhere to the format given in the below table.
2. The question paper setters are also requested to set the questions in the following way:

a. 80% of Questions should be Memory and Understanding based

b. 20% of Questions should be Creativity, Application and Skill based

The examiner is requested to set question paper in such a way that the entire syllabus is reflected in the question paper set by her/him.

Bloom's Taxonomy	Weigh tage	Module-I	Module-II	Module-III	Module-IV	Module-V
Knowledge/ Remember	30%	1 Essay	1 Essay	1 Essay	1 Short	1 Short
Understanding	20%		1 Essay	1 Short	1 Essay	1 Essay
Application	20%	1 Short	1 Short	1 Essay	1 Essay	1 Essay
Analysis	15%		1 Short	1 Short		
Evaluate	15%	1 Essay			1 Short	

B. Sc. Industrial Chemistry
Course-7A, Semester-V
BLUE PRINT
(Unit processes in Organic Synthesis-II)

Sl. No	Module	Name of the chapter	10 Marks	5 Marks
1	Module-I	Esterification	2	1
2	Module-II	Hydrolysis	2	2
3	Module-III	Amination by reduction	2	2
4	Module-IV	Amination by Ammonolysis	2	2
5	Module-V	Alkylation	2	1

Skill Enhancement Course (SEC) Semester V

Course 7A: **Unit Processes in Organic Synthesis – II Model Paper**

Max.Marks:75 Time: 3 hrs.

SECTION - A

Answer any five of the following questions.

Each answer carries 5 marks (5x5=25 Marks)

1. Discuss about the formation of esters by addition to unsaturated systems.
2. Write a short note on thermodynamics of ethyl acetate hydrolytic reaction.
3. What are the factors affecting the rate of hydrolysis?
4. Discuss the iron and acid reduction of nitrobenzene.
5. Write about the reaction conditions for catalytic reduction.
6. What are the physical and chemical factors affecting ammonolysis?
7. What are the catalysts used in ammonolysis reactions?
8. What are the factors affecting the rate of alkylation?

SECTION - B

Answer all the questions.

Each answer carries 10 marks (5x10=50 Marks)

1. (a).Explain the industrial continuous process for the manufacture of ethyl acetate.

   Or

   (b).Discuss the industrial process for the manufacture of glyceryl trinitrate.

2. (a).Discuss about the technical preparation of soaps.

   Or

   (b).Explain the manufacture of fatty acids.

3. (a).Describe the industrial manufacture of p-phenylenediamine.

   Or

   (b).Give a detailed account on the electrolytic reduction and metal-alkali reduction of nitro compounds.

4. (a).Explain the industrial manufacture continuous process of aniline from chlorobenzene.

   Or

   (b).Explain the kinetics of ammonolysis.

5. (a).Explain the industrial manufacturing of alkyl aryl detergents.

   Or

   (b).Discuss about the equipment for alkylation.

Industrial Chemistry Course 6-B: ELECTRO INDUSTRIAL CHEMISTRY

I. Learning Outcomes:

Students after successful completion of the course will be able to:

1. This course will help strengthen knowledge regarding various furnaces and abrasive materials in industries.
2. To learn about the industrial preparations of alkaline and chlorine.
3. It focuses on fundamental as well as applications of batteries.
4. It will cover different kind of fuel cells and solar cells.

II. Syllabus :(Total Hours: 90 including Teaching, Lab, Field Skills Training, Unit tests etc.)

MODULE- I: ELECTRO THERMAL INDUSTRIES **12 h**

Introduction to furnaces. Advantages of electrical furnaces. Classification of electric furnaces. Selection of furnaces.

Abrasives-Kinds of abrasives-Manufacture of artificial abrasives and uses.

1) Silicon carbide or carborundum 2) Calcium carbide 3) Alundum 4) Boron carbide

5) Boron Nitride 6) Boron carbonitride and 7) Synthetic graphite. Uses of abrasives.

MODULE-II ALKALI AND CHLORINE- I **12 h**

Introduction - Common salt - Method of manufacture.

Caustic soda. Different type of cathodes (Diaphragm cells, mercury cells and membrane cells)

Cells used -1. Diaphragm cells 2. Porous diaphragm cells-Nelson cell 3. Hooker cell

4. The Dow cell 5. Diamond cell and 6. Vorce cell.

Manufacture of caustic soda and chlorine by using diaphragm cells- Physico-chemical principles.

MODULE-III ALKALI AND CHLORINE - II **12 h**

Mercury cathode cells-The Castner Kellner cell - Modern mercury cells- De-Nora cells-Physico-chemical principles.

Lime soda process for the manufacture of caustic soda.

Deacon's method for the manufacture of chlorine.

Manufacture of Soda ash by 1. Leblanc process 2. Solvay ammonia soda process

3. Dual process and 4. Electrolytic process.

MODULE - IV BATTERIES **12 h**

Batteries: Primary and secondary batteries, battery components and their role and characteristics of battery. Working of following batteries: Lead Acid Battery, Nickel based batteries, Sodium based batteries, Lithium based batteries – Li-Ion & Li-poly.

MODULE - V FUEL CELLS & SOLAR CELLS **12 h**

1. Fuel cells: Introduction, Classification, Choice of electrolyte. Electrodes and requirement of Electro catalysis. Working of Hydrogen oxygen fuel cell and hydrocarbon – oxygen fuel cell

2. Biochemical Fuel cells - Characteristic, Classification, Mechanisms and Application.

Use of carbon in fuel cells, Fuel cells using Carbon Nano materials.

3. Solar cells: Photochemical and photo galvanic conversion.

III. References

1. Industrial Chemistry (including chemical - engineering) - B.K. Sharma - Goel publishing house, Meerut
2. Jayashree Ghosh, Fundamental Concepts of Applied Chemistry, 1st Edition, S.Chand & Co. Ltd, New Delhi, 2006.
3. Stocchi, E. (1990), Industrial Chemistry, Vol -I, Ellis Horwood Ltd. UK.
4. Kent, J. A. (Ed) (1997), Riegel's Handbook of Industrial Chemistry, CBS Publishers, New Delhi.
5. P. C. Jain, M. Jain: *Engineering Chemistry,* Dhanpat Rai & Sons, Delhi.
6. R. Gopalan, D. Venkappayya, S. Nagarajan: *Engineering Chemistry,* Vikas Publications, New Delhi.
7. B. K. Sharma: *Engineering Chemistry*, Goel Publishing House, Meerut
8. O. P. Vermani, A. K. Nebula: *Industrial Chemistry,* Galgotia Publications Pvt. Ltd., New Delhi.
9. R. Narayan and B. Viswanathan, Chemical and Electrochemical Energy Systems, University Press, 1998.
10. C. Vincent and B. Sc. Rosati, Modern Batteries, An introduction to Electrochemical Power Sources, Arnold, 1997.
11. M. Sharon and M. Sharon, Nano Forms of Carbon and its Application, Monad Nano Tech, Mumbai, 2007.
12. S. P. Sukhatme, Solar Energy Principles of Thermal Collection and Storage, Tata McGraw Hill, 2006

Skill Enhancement Course (SEC) Semester V

***Course 6 - B*: ELECTRO INDUSTRIAL CHEMISTRY -PRACTICAL SYLLABUS**

IV. Learning Outcomes:

On successful completion of this practical course, student shall be able to:

1. Will be able to understand basics in designing an electrochemical cell.
2. Various synthetic strategies for preparation of good electrochemical support material for electrodes in fuel cells as well as batteries will be undertaken
3. Develop skills of working and set up of electrochemical cells (potentiometry and pH-metry, conductometry).

V. Practical (Laboratory) Syllabus: (30hrs) (Max.50 Marks)

1. Construct a Daniel cell and determine the voltage of the cell at varying concentration.
2. Determination of electrochemical equivalent of copper.
3. Determination of cell constant.
4. Determination of equivalent conductance, degree of dissociation and dissociation constant of a weak acid.
5. Determination of temperature dependence of e.m.f of a cell.
6. Determination of solubility and solubility product of sparingly soluble salt conductometrically. (Conductometric titration of Lead Nitrate against Sodium Sulphate and to determine the solubility of Lead Sulphate.)

VI. Lab References:

1.O. P. Virani and A.K. Nebula, Applied Chemistry theory and Practice, New Age, International Publishers, II Edition.

2. Robert Bruce Thompson, Illustrated Guide to Home Chemistry Experiments O'Reilly Media. Inc.

3. S. W. Rajbhoj and Dr. T. K. Chondhekar, Systematic Experimental Physical Chemistry, Anjali Publication Aurangabad.

VII. Co-Curricular Activities

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

1. For Teacher: Training of students by the teacher in laboratory and field for not less than15 hours on the field techniques/skills of how the electric furnaces work, how to prepare chlorine and caustic soda in industry and also working of batteries and solar cells.

2. For Students: Student shall visit a related industry/chemistry laboratory in universities/research organizations/private sector facility and observes the furnaces. 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.*

5. 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 relevant videos and material.
3. Visits of abilities, firms, research organizations etc.
4. Invited lectures and presentations on related topics by field/industrial experts.

Guidelines to the Paper Setter: The **Industrial Chemistry** V Semester **Course 6-B-Electro Industrial Chemistry** question paper consists of 2 sections.

PART -A consists of EIGHT short answer questions out of which 5 are to be answered.

Each question carries 5 marks.

PART– B: consists of FIVE internal choice essay questions and each question carries 10 marks.

Note:

1. The question paper setters are requested to kindly adhere to the format given in the below table.
2. The question paper setters are also requested to set the questions in the following way:

a. 80% of Questions should be Memory and Understanding based

b. 20% of Questions should be Creativity, Application and Skill based

The examiner is requested to set question paper in such a way that the entire syllabus is reflected in the question paper set by her/him.

Bloom's Taxonomy	Weigh tage	Module-I	Module-II	Module-III	Module-IV	Module-V
Knowledge/ Remember	30%	1 Essay	1 Essay		1 Short	1 Short
Understanding	20%		1 Essay	1 Short	1 Essay	1 Essay
Application	20%	1 Short	1 Short	1 Essay	1 Essay	1 Essay
Analysis	15%			1 Short		1 Short
Evaluate	15%	1 Essay	1 Short	1 Essay		

B. Sc. Industrial Chemistry
Course-6-B, Semester-V
BLUE PRINT
(Electro Industrial Chemistry)

Sl. No	Module	Name of the chapter	10 Marks	5 Marks
1	Module-I	Electro thermal Industries	2	1
2	Module-II	Alkali and Chlorine-I	2	2
3	Module-III	Alkali and Chlorine-II	2	2
4	Module-IV	Batteries	2	1
5	Module-V	Fuel Cells and Solar Cells	2	2

Skill Enhancement Course (SEC) Semester V

Industrial Chemistry Course 6-B: ELECTRO INDUSTRIAL CHEMISTRY

Max.Marks:75 Time: 3 hrs.

SECTION -A (5x5=25 Marks)

Answer any five of the following questions. Each answer carries 5marks

1. What are the different kinds of electrical furnaces?
2. Write the manufacture process of silicon carbide abrasive.
3. Discuss about Nelson cell with neat diagram
4. Discuss about Hooker cell with neat diagram
5. Describe the manufacture of Soda ash by Leblanc process
6. Describe the manufacture of Soda ash by Electrolytic process
7. Discuss about Nickel based batteries.
8. Explain about the Bio chemical fuel cells.

SECTION – B (5x10 = 50 Marks)

Answer all the questions. Each answer carries 10 marks

1. (a).Write the manufacture process and uses of following abrasives

i) Calcium carbide ii) Alundum

Or

(b).What are Abrasives? Describe the manufacture of artificial abrasives and their uses.

2. (a). Write the detail process of manufacture of caustic soda and chlorine by using diaphragm cell.

Or

(b).Give a detailed account on different types of cathodes.

3. (a). Discuss the manufacture of caustic soda by Lime Soda process

Or

(b).Explain the manufacture of Chlorine by Deacon's method.

4. (a). Describe the working of the lead acid battery.

Or

(b). Explain the working of Hydrogen – Oxygen fuel cell.

5. (a).Discuss the working of hydrogen oxygen fuel cell and hydrocarbon-oxygen fuel cell.

Or

(b).Give a detailed account of photochemical and photo galvanic conversion of solar cells.

Skill Enhancement Course (SEC) Semester V

Industrial Chemistry Course 7-B: CORROSION AND ITS PREVENTION

I. Learning Outcomes:

- This course will create awareness of corrosion and its control process
- It focuses on protective metallic coatings for prevention of corrosion
- It focuses on protective coatings of materials.
- It covers about the insulating materials in electric industries and also aware about semiconductors.

MODULE-I CORROSION AND ITS CONTROL **12 h**

CORROSION AND ITS CONTROL – Introduction - Economic aspects of corrosion - Dry or Chemical Corrosion - Wet or electrochemical corrosion - Mechanism of Electrochemical Corrosion.

Galvanic Corrosion - Concentration Cell Corrosion - Differential aeration corrosion - Pitting Corrosion - Underground or soil corrosion - Passivity.

MODULE-II CORROSION AND ITS CONTROL **12 h**

Factors Influencing Corrosion - Microbiological Corrosion Atmospheric corrosion – Corrosion Control - Proper designing - Using pure metal - Using metal alloys.

Chemical conversion – Coating - Phosphating - Chromising - Treatment of metal surfaces hot dipping - Use of inhibitors.

MODULE-III PROTECTIVE COATINGS **12 h**

PROTECTIVE COATINGS - Introduction - Metallic Coatings - Various methods of cleaning articles before electrode position – Electroplate and - Electroplating methods.

Pre-treatment of the surface – Metallic Coatings - Hot Dipping -Cementation or Impregnated Coatings - Sprayed Metal Coatings - Cladding – Vapour Deposition.

MODULE-IV PAINTS **12 h**

Paints - ingredients and their functions Required Properties of a Paint- Paint Constituents and Their Functions - Manufacture of Paint.

Types of Pigments - Characteristics of pigment - Oils - Uses in Paint Emulsion Paints – Special Paints - Paint Remover Varnishes.

MODULE-V INSULATORS AND SEMICONDUCTORS **12 h**

Electrical Insulating Materials - Dielectric properties - Requirements of an Electrical Insulating Material - Classification of insulating material - Electrical Rigid Insulations.

Semiconductors - Introduction - Classification – Degenerate semiconductors – Super conductors.

III. References

1. M.G. Fontana: Corrosion Engineering, McGraw Hill International Book Co. London.
2. L.L. Shreir: Corrosion, Vol I and Vol II, Newness Butterworths, Edward Arnold Ltd, London.
3. J.C. Scully: Fundamental of Corrosion, Pergamon Press Inc. New York, USA.
4. V.S. Sastry: Corrosion Inhibitors, Principles & Applications, John Wiley & Sons.
5. C.C. Nathan: Corrosion Inhibitors, NACE, Houston, Texas.
6. Corrosion - Causes and Prevention: Speller. F. N.
7. Material Science mini refresher by H.S. Bawa, Tata publisher India.

Skill Enhancement Course (SEC) Semester V

***Course7-B*: CORROSION AND ITS PREVENTION -PRACTICAL SYLLABUS**

IV. Learning Outcomes:

On successful completion of this practical course, student shall be able to:

1. Chalk out a plan to decrease the rate of corrosion.
2. Preparation of pigment.
3. To study about the Rate of corrosion with respect to Aluminium and Iron plates
4. To determine the effect of temperature on rate of corrosion

V. Practical (Laboratory) Syllabus :(30hrs) (Max.50 Marks)

1. Electroless metallic coatings on ceramic and plastic material.
2. Preparation of pigment (zinc oxide)
3. To determine the rate of corrosion on different metallic plates (Iron, Aluminium) in various Concentrations of HCl.
4. To determine the effect of temperature on rate of corrosion in acidic medium.
5. To determine the rate of corrosion on a metallic plate in acidic medium.
6. To determine the rate of corrosion on an Aluminium plate in basic medium.

VI. Lab References:

1. Analytical Chemistry by Gary D. Christian 6th edition Wiley publication.
2. Senior Practical Physical Chemistry, B.D. Khosla, V.C. Garg, Adarsh Gulati, R Chand and Co.
3. Applied Chemistry Theory and Practice, O.P. Virani, A.K. Nebula. New Age International Publishers, 2nd Edition.
4. S.W. Rajbhoj and T. K. Chondhekar, Systematic Experimental Physical Chemistry, Anjali Publication, Second Edition 2000.
5. Sunita Rattan, Experiments in Applied Chemistry, S.K. Kataria & Sons, Second edition, 2008
6. Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi (2011).
7. UGC practical manual for experimental analysis.

VII. Co-Curricular Activities

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

1. For Teacher: Training of students by the teacher in laboratory and field for not less than15 hours on the field techniques/skills of corrosion formation observations in nature.

2. For Students: Student shall visit a related industry/chemistry laboratory in universities/research organizations/private sector facility and observes corrosion process and its prevention. Write their observations and submit a hand written fieldwork/project work report notexceeding10 pages in the given format to the teacher. And also observe the semiconductors, insulators used in industry.

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.*

5. 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 relevant videos and material.
3. Visits of abilities, firms, research organizations etc.
4. Invited lectures and presentations on related topics by field/industrial experts.

Guidelines to the Paper Setter: The V Semester **Industrial Chemistry Course 7-B - Corrosion and its prevention** - question paper consists of 2 sections.

PART -A consists of EIGHT short answer questions out of which 5 are to be answered.

Each question carries 5 marks.

PART– B: consists of FIVE internal choice essay questions and each question carries 10 marks.

Note:

1. The question paper setters are requested to kindly adhere to the format given in the below table.
2. The question paper setters are also requested to set the questions in the following way:

a. 80% of Questions should be Memory and Understanding based

b. 20% of Questions should be Creativity, Application and Skill based

The examiner is requested to set question paper in such a way that the entire syllabus is reflected in the question paper set by her/him.

Bloom's Taxonomy	**Weigh tage**	**Module-I**	**Module-II**	**Module-III**	**Module-IV**	**Module-V**
Knowledge/ Remember	30%	1 Essay	1 Essay	1 Essay	1 Short	1 Short
Understanding	20%	1 Short	1 Essay	1 Short	1 Essay	1 Essay
Application	20%	1 Short	1 Short	1 Essay	1 Essay	1 Essay
Analysis	15%		1 Short			
Evaluate	15%	1 Essay		1 Short		

B. Sc. Industrial Chemistry
Course-7B, Semester-V (Corrosion and its prevention)
BLUE PRINT

Sl. No	**Module**	**Name of the chapter**	**10 Marks**	**5 Marks**
1	Module-I	Corrosion and its control-I	2	2
2	Module-II	Corrosion and its control-II	2	2
3	Module-III	Protective coatings	2	2
4	Module-IV	Paints	2	1
5	Module-V	Insulators and Semiconductors	2	1

Semester–V Model paper

Industrial Chemistry Course 7-B: CORROSION AND ITS PREVENTION

Max.Marks:75 Time: 3 hrs.

SECTION -A (5x5=25 Marks)

Answer any five of the following questions. Each answer carries 5marks

1. Write the Mechanism of Electrochemical Corrosion.
2. Details of Concentration Cell Corrosion.
3. Explain microbial corrosion
4. Discuss about chemical conversion chromate coatings.
5. Write about protective metallic coatings by hot dipping method.
6. Write about protective metallic coatings by vapour Deposition method.
7. Describe about different types of Pigments
8. Write about Electrical Rigid Insulations.

SECTION – C (5x10 = 50 Marks)

Answer all the questions. Each answer carries 10 marks

1. (a).Write the different types of corrosion

Or

(b).Explain galvanic corrosion.

2. (a). Write about corrosion control and Prevention techniques.

Or

(b).Explain in detail about chemical corrosion.

3. (a).Discuss about electroplate and electroplating methods.

Or

(b).Explain impregnated coatings in detail.

4. (a).What are required properties of Paint and write any method for manufacture of Paint.

Or

(b).Explain the process of manufacture of paint.

5. (a). What is requirement for Insulating Materials and discuss about its classification?

Or

(b).Describe about Classification of semiconductors and explain of Degenerate semiconductors.

Skill Enhancement Course (SEC) Semester V

Industrial Chemistry Course 6C: Medicinal Chemistry

I. Learning Outcomes:

After completion of the course, the student can be able to

1. Understand the terms used in medicinal chemistry and properties of drugs.
2. Acquire knowledge about pharmacokinetics and pharmacodynamics of the drugs.
3. Explain different sources and classes of drugs.
4. Write the nomenclature and synthesis of drugs.
5. Apply the concept of structure activity relationship in studies of drug bioactivity.
6. Explain the mechanism of action of drugs.
7. Describe the causes, treatments of cancer and classification of anticancer agents.

II. Syllabus :(Total Hours: 90 including Teaching, Lab, Field Skills Training, Unit tests etc.)

Module – I

Drug's introduction **12h**

Definitions – Activity, potency, leads, analogues. Receptors, ligand, pharmacophore, drug. SAR and QSAR with one example. Modern-day drug discovery and design. Desirable properties of drugs – Bioavailability, Solubility, Structure and Stability. Sources of drugs, drug administration.

Module – II

Drug action **12h**

The pharmacokinetic phase (ADME) – Absorption, Distribution, Metabolism, Excretion. Lead optimisation and ADME. The pharmacodynamic phase introduction. Nomenclature of drugs – Chemical name, generic name and trade names with examples. Classification of drugs based on Chemical structure, Pharmacological action, Physiological classification.

Module– III

Drug Synthesis **12h**

Structure, synthesis, mode of action, properties and uses of the following drugs.

Promazine (tranquillizers), Levodopa (antiparkinsonism agents), Frusemide (antihypertensive drugs), Chloroquine (antimalarials), Omeprazole (antiulcer agents), Metformin (antidiabetics).

Module – IV

Structure Activity Relationship (SAR) of representative drugs **12h**

Phenothiazines (tranquillizers), Sulphonamides (antibacterial) Penicillins and Cephalosporins (antibiotics), 4-substituted quinolines (antimalerials).

Module – V

Cancer therapy **12h**

Cancer introduction, factors responsible for cancer, types of cancer and various treatments of cancer. Classification of chemotherapeutic agents. DNA Alkylating agents and DNA intercalating agents. Natural products as anticancer agents. SAR of Combretastatin A-4.

III. Recommended books/References:

1. Textbook of Medicinal Chemistry Vol I by V. Alagarsamy.
2. Textbook of Medicinal Chemistry Vol II by V. Alagarsamy.
3. Medicinal Chemistry by Ashutosh Kar
4. An Introduction to Medicinal Chemistry fifth edition by Graham L. Patrick.
5. Medicinal Chemistry Second Edition by Gareth Thomas.
6. Fundamentals of Medicinal Chemistry by Gareth Thomas.
7. Textbook of Organic Medicinal and Pharmaceutical Chemistry by Wilson and Gisvold's.
8. Foye's Principles of Medicinal Chemistry by Thomas L. Lemke, David A. Williams, Victoria F. Roche, S. William Zito.
9. Burger's Medicinal Chemistry and Drug Discovery: Therapeutic Agents: Volume – 5.
10. https://www.cancer.gov/about-cancer
11. https://www.cancer.gov/about-cancer/treatment/types
12. Tubulin-Interactive Natural Products as Anticancer Agents,Journal of Natural Products 2009, 72, 3, 507-515 (Review)
13. Essentials of Foye's Principles of Medicinal Chemistry by Thomas L. Lemke, David A. Williams, Victoria F. Roche, S. William Zito.

Course – 6C: Medicinal ChemistryPractical Syllabus

IV. Laboratory-Skill Outcomes:

At the end of the course students will be able to

6. Understand the apparatus handling technique.
7. Demonstrate a clear understanding of the reactions of key organic functional groups.
8. Perform synthesis of drugs.
9. Acquire skill for workup procedures.
10. Understand the concept of purification of drugs.
11. Discuss the importance of 'green chemistry' considerations during drug manufacture.

V. Practical (Laboratory) Syllabus:

Drug Preparation (Any Four) **30h**

a) Aspririn

b) Coumarin–3–Carboxylic Acid

c) Isoniazid

d) Isatin

e) Paracetamol

f) Phenyl-azo-beta-naphthol

VI. Recommended books/References:

1. Advanced practical Medicinal Chemistry by Ashutosh Kar

VII. Co-Curricular Activities:

c) **Mandatory**: (Training of students by teacher on field related skills: 15 hours)
- **For Teacher**: Training of students by the teacher in the classroom or in the laboratory for not less than 15 hours on field related quantitative techniques for drug synthesis.
- **For Student**: Individual visit to any one of the local field agencies, research laboratories in universities/research organizations/private sector culminating writing and submission of a hand-written fieldwork/project work Report not exceeding 10 pages in the given format.
- **Max marks** for fieldwork/project work Report: 05.
- **Suggested Format** for fieldwork/project work: Title page, student details, index page, details of places visited, observations, findings and acknowledgements.
- **Unit tests** (IE).

d) **Suggested Co-Curricular Activities**:
- Training of students by related industrial experts.
- Visits to research organizations and laboratories.
- Invited lectures and presentations on related topics by field / industrial experts.
- Assignments.
- Seminars, workshops, group discussions, quiz, debates etc. (on related topics).
- Preparation of videos on tools, techniques and applications of drugs.

Guidelines to the Paper Setter: The syllabus **Industrial Chemistry Course 6C- Medicinal Chemistry-** paper consists of 2 sections.

PART -A consists of EIGHT short answer questions out of which 5 are to be answered.

Each question carries 5 marks.

PART– B: consists of FIVE internal choice essay questions and each question carries 10 marks.

Note:

1. The question paper setters are requested to kindly adhere to the format given in the below table.
2. The question paper setters are also requested to set the questions in the following way:

a. 80% of Questions should be Memory and Understanding based

b. 20% of Questions should be Creativity, Application and Skill based

The examiner is requested to set question paper in such a way that the entire syllabus is reflected in the question paper set by her/him.

Bloom's Taxonomy	Weigh tage	Module-I	Module-II	Module-III	Module-IV	Module-V
Knowledge/ Remember	30%	1 Essay	1 Essay		1 Short	1 Short
Understanding	20%		1 Essay	1 Short	1 Essay	1 Essay
Application	20%	1 Short	1 Short	1 Essay	1 Essay	1 Essay
Analysis	15%		1 Short			1 Short
Evaluate	15%	1 Essay	1 Short	1 Essay		

B. Sc. Industrial Chemistry
Course-6C, Semester-V(Course 6C: Medicinal Chemistry)
BLUE PRINT

Sl. No	Module	Name of the chapter	10 Marks	5 Marks
1	Module-I	Drug's Introduction	2	2
2	Module-II	Drug Action	2	2
3	Module-III	Drug Synthesis	2	2
4	Module-IV	Structure Activity Relationship (SAR) of representative drugs	2	1
5	Module-V	Cancer Therapy	2	1

Semester–V Model paper

Industrial Chemistry Course 6C: Medicinal Chemistry

Max.Marks:75 Time: 3 hrs.

SECTION - A (5x5=25 Marks)

Answer any five of the following questions. Each answer carries 5 marks

1. Discuss about the sources of drugs.
2. Classify the drugs based on chemical structure.
3. Give the synthesis and mode of action of promazine.
4. Write the SAR of antibacterial sulphonamides.
5. What are the factors responsible for cancer?
6. Discuss about the classification of chemotherapeutic agents.
7. Write a short note on the pharmacodynamic phase of the drug.
8. Discuss about the drug administration.

SECTION - B (5x10=50 Marks)

Answer all the questions. Each answer carries 10 marks

1. (a).Explain the desirable properties of drugs.

Or

(b).Discuss with examples SAR and QSAR. Explain modern drug discovery and design.

2(a).Explain the pharmacokinetic phase (ADME) of the drug.

Or

(b).Describe the classification of drugs based on pharmacological action and physiological action.

3. (a).Write the synthesis and mode of action of Levodopa.

Or

(b).Write the synthesis and mode of action of chloroquine.

4. (a).Explain the structure Activity Relationship (SAR) of Penicillins.

Or

(b).Discuss the structure Activity Relationship (SAR) of Phenothiazines.

5.(a).Explain about the DNA Alkylating agents and DNA intercalating agents.

Or

(b).Describe the various types of cancer and their treatment.

Skill Enhancement Course (SEC) Semester V

Industrial Chemistry Course 7C: Pesticides and Green Chemistry

I. Learning Outcomes:

On completion of this course, the student will be able to

1. Understand the basic knowledge of pesticides and their classification.
2. Explain the synthetic methods of pesticides.
3. Acquire knowledge about the different types of pesticide formulations and their use.
4. Explain concepts in green chemistry.
5. State and explain the principles of green chemistry.
6. Identify the need of green chemistry and green synthesis.
7. Think to design and develop materials and processes that reduce the use and generation of hazardous substances in industry.
8. Get ideas of innovative approaches to environmental and societal challenges.
9. Critically analyse the existing traditional chemical pathways and processes and creatively think about bringing environmentally benign reformations in these protocols.

II. Syllabus :(Total Hours: 90 including Teaching, Lab, Field Skills Training, Unit tests etc.)

Module-I

Pesticides **12h**

Introduction to pesticides, advantages and disadvantages of pesticides, types of pesticides – Insecticides, Fungicides, Herbicides, Weedicides, Rodenticides plant growth regulators, Pheromones and Hormones. Brief discussion with examples, Structure and uses.

Module-II

Pesticides Synthesis **12h**

Synthesis and uses of representative pesticides in the following classes: Organochlorines (DDT, Gammexene); Organophosphates (Malathion, Parathion); Carbamates (Carbofuran and carbaryl); Quinones (Chloranil); Anilides (Alachlor and Butachlor).

Module – III

Pesticide Formulations **8h**

Dust and Granules, Wettable powders, seed disinfectant, Surfactants, Emulsifiable concentrates, Aerosols, Sprays, and Controlled Release Formulations.

Module-IV **14h**

Green Chemistry

Introduction: Definition of green Chemistry, need of green chemistry, twelve principles of Green Chemistry with their explanations and examples; Green Synthesis-Maximum utilization of reactants and reagents (atom economy). Selection of solvent: Aqueous phase reactions, Reactions in ionic liquids, Solid supported synthesis, Solvent free reactions (solid phase reactions), and Green catalysts: Phase transfer catalysts (PTC) and Biocatalysts.

Module-V **14h**

Green Synthesis

Green Synthesis of the following compounds: Styrene, Adipic Acid, Catechol, BHT, Methyl Methacrylate, Urethane, 4- aminodiphenylamine, benzyl bromide, Acetaldehyde, Furfural, Ibuprofen, Paracetamol, Citral.

III. Recommended Books/References:

1. Fundamentals of industrial chemistry – pharmaceuticals, polymers, and business by John A. Tyrell.
2. Riegel's Handbook of Industrial Chemistry ninth edition Edited by James A. Kent.
3. Industrial chemistry by B.K. Sharma. Goel Publishing House, Meerut.
4. E. Stocchi: Industrial Chemistry, Vol -I, Ellis Horwood Ltd. UK.
5. Chemistry of pesticides by N. K. Roy
6. R. Cremlyn: Pesticides, John Wiley.
7. Pesticides Formulations – Van Wade. Velkenburg, 1973.
8. Pesticides Synthesis – Mavy, Kohn, Menn, 1979.
9. V.K. Ahluwalia & M.R. Kidwai: New Trends in Green Chemistry, Anamalaya Publishers (2005).
10. P.T. Anastes & J.K. Warmer: Oxford Green Chemistry- Theory and Practical, University Press (1998).
11. A.S. Matlack: Introduction to Green Chemistry, Marcel Deckkar (2001).
12. Kirchoff, M. & Ryan, M.A. Greener approaches to undergraduate chemistry experiment. American Chemical Society, Washington DC (2002).

Course – 7C: Pesticides and Green Chemistry (Practical Syllabus)

IV. Laboratory - Skills Outcomes:

On successful completion of this practical course, student shall be able to:

1. List out, identify and handle various equipment in the laboratory.
2. Learn the procedures of green synthesis.
3. Acquire skills in Microwave assisted organic synthesis.
4. Perform some applications of green synthesis.

V. Practical (Laboratory) Syllabus **30h**

The list of suggestive experiments is given below. However, depending upon available resources, any three experiments may be conducted)

1. Benzoin condensation using Thiamine Hydrochloride as a catalyst (instead of cyanide).
2. Formation of Chalcones – A Greener Alternative.
3. Preparation of Salicylic Acid (Aspirin) by Microwave Assisted Method.
4. Green Synthetic Process for Acetanilide.
5. Green Synthetic Process for Dibenzal Propanone.
6. Green Synthetic Process for trans esterification of vegetable oil to crude bio-diesel.

VI. Recommended Books/References:

1. Anastas, P.T & Warner, J.C. Green Chemistry: Theory and Practice, Oxford University Press (1998).
2. Kirchoff, M. & Ryan, M.A. Greener approaches to undergraduate chemistry experiment. American Chemical Society, Washington DC (2002).
3. Ryan, M.A. Introduction to Green Chemistry, Tinnesand; (Ed), American Chemical Society, Washington DC (2002).
4. Sharma, R.K.; Sidhwani, I.T. and Chaudhari, M.K. I.K. Green Chemistry Experiment: A monograph, International Publishing ISBN 978-93-81141-55-7 (2013).
5. Cann, M.C. and Connelly, M. E. Real world cases in Green Chemistry, American Chemical Society (2008). UGC DOCUMENT ON LOCF CHEMISTRY 83
6. Cann, M. C. and Thomas, P. Real world cases in Green Chemistry, American Chemical Society (2008).
7. Lancaster, M. Green Chemistry: An Introductory Text RSC Publishing, Second Edition, 2010.

8. Pavia, D. L., Lampman, G.M., Kriz, G.S. & Engel, R.G. Introduction to Organic Laboratory Techniques: A Microscale and Macro Scale Approach, W. B. Saunders, 1995.

VII. Co-Curricular Activities:

a) Mandatory: (Training of students by teacher on field related skills: 15 hours)

1. **For Teacher**: Training of students by the teacher in the classroom or in the laboratory for not less than 15 hours on field related quantitative techniques for pesticides synthesis and formulations, solid phase green synthesis and biocatalysts.
2. **For Student**: Individual visit to any one of the local field agencies, research laboratories in universities/research organizations/private sector culminating writing and submission of a hand-written fieldwork/project work Report not exceeding 10 pages in the given format.
3. Max marks for fieldwork/project work Report: 05.
4. Suggested Format for fieldwork/project work: Title page, student details, index page, details of places visited, observations, findings and acknowledgements.
5. Unit tests (IE).

b) Suggested Co-Curricular Activities:

1. Training of students by related industrial experts.
2. Visits to research organizations and laboratories.
3. Invited lectures and presentations on related topics by field / industrial experts.
4. Assignments.
5. Seminars, workshops, group discussions, quiz, debates etc. (on related topics).
6. Preparation of videos on tools, techniques and applications of pesticide synthesis, formulations and green chemistry.

Guidelines to the Paper Setter

The V Semester **Industrial Chemistry Course- 7C** consists of **Pesticides and Green Chemistry**- question paper consists of 2 sections.

PART -A consists of EIGHT short answer questions out of which 5 are to be answered.

Each question carries 5 marks.

PART– B: consists of FIVE internal choice essay questions and each question carries 10 marks.

Note:

1. The question paper setters are requested to kindly adhere to the format given in the below table.
2. The question paper setters are also requested to set the questions in the following way:

a. 80% of Questions should be Memory and Understanding based

b. 20% of Questions should be Creativity, Application and Skill based

The examiner is requested to set question paper in such a way that the entire syllabus is reflected in the question paper set by her/him.

Bloom's Taxonomy	Weigh tage	Module-I	Module-II	Module-III	Module-IV	Module-V
Knowledge/ Remember	30%	1 Essay	1 Essay		1 Short	1 Short
Understanding	20%		1 Essay	1 Short	1 Essay	1 Essay
Application	20%	1 Short	1 Short	1 Essay	1 Essay	1 Essay
Analysis	15%		1 Short			1 Short
Evaluate	15%	1 Essay	1 Short	1 Essay		

B. Sc. Industrial Chemistry
Course-7C, Semester-V
BLUE PRINT
(Course 7C: Pesticides and Green Chemistry)

Sl. No	Module	Name of the chapter	10 Marks	5 Marks
1	Module-I	Pesticides	2	1
2	Module-II	Pesticide Synthesis	2	2
3	Module-III	Pesticide formulations	2	2
4	Module-IV	Green Chemistry	2	2
5	Module-V	Green Synthesis	2	1

Semester–V Model paper

Course 7C: Pesticides and Green Chemistry

Max.Marks:75 **Time: 3 hrs.**

SECTION - A (5x5=25 Marks)

Answer any five of the following questions. Each answer carries 5 marks

1. What are the advantages and disadvantages of pesticides?
2. Write the synthesis and uses of DDT?
3. Discuss about the emulsifiable concentrates in pesticide formulations.
4. Explain the green synthesis.
5. Write short note on Pheromones and Hormones
6. Discuss about the Phase Transfer Catalysts (PTC).
7. Explain the green synthesis of methyl methacrylate.
8. Explain the green synthesis of 4- aminodiphenylamine.

SECTION – B (5x10=50 Marks)

Answer all the questions. Each answer carries 10 marks

9. (a).Brief discussion of rodenticides and plant growth regulators with examples.

Or

(b).Give a brief discussion about Insecticides and weedicides.

10. (a).Write the synthesis and uses of Malathion and parathion?

Or

(b).Explain the synthesis of quinones and anilides.

11. (a).Discuss about the controlled release formulations.

Or

(b).Explain Emulsifible concentrates and wettable powders.

12. (a).Explain the twelve principles of green chemistry with examples.

Or

(b).Discuss about the aqueous phase reactions in green chemistry.

13. (a).Explain the green synthesis of adipic acid and catechol.

Or

(b).Discuss the green synthesis of Methyl methacrylate and Citral.