JYOTI NIVAS COLLEGE AUTONOMOUS, BANGALORE – 560 095

Programme: B.Sc.

VI Semester

CHEMISTRY - VII NEP

Advanced Inorganic and Organic Chemistry II

CREDITS: 4 **NO. OF HOURS: 60**

COURSE CODE: 21VICH7T

Course Objectives:

This course aims to impart to the student, knowledge of:

I. Understanding Core Concepts:

1. A comprehensive knowledge of industrial materials (refractories, abrasives, glass, ceramics, cement, paints, varnishes, fuels, explosives, and propellants) focusing on properties, classifications, manufacturing processes, and applications.
2. The principles of pharmaceutical chemistry, including drug classification, synthesis, and mechanisms of action.
3. The fundamentals of green chemistry, emphasizing atom economy, reducing toxicity, and using green solvents.
4. A deep understanding of advanced materials (nanomaterials, conducting polymers, superconductors), including their properties, preparation methods, and applications.
5. The nomenclature, reactivity, and reaction mechanisms of organic compounds, including aldehydes, ketones, carboxylic acids, their derivatives, tautomerism, enolate chemistry, and organic rearrangements.

II. Analytical Skills:

6. Analyzing the properties and suitability of various industrial and advanced materials for specific applications.
7. The calorific value of fuels and significance of octane numbers.
8. The environmental and safety impacts of industrial materials, fuels, pharmaceuticals, and advanced materials.
9. Water quality using standard analytical methods and analyze reaction mechanisms involving carbonyl compounds, carboxylic acid derivatives, tautomers, and enolates.

III. Practical Applications:

10. Industrial and advanced materials, and water purification technologies in practical and industrial contexts, ensuring safety and efficiency.
11. Key pharmaceuticals and apply green chemistry principles to optimize chemical processes.
12. Organic chemistry (carbonyl compounds, carboxylic acid derivatives, tautomerism, and enolate chemistry) in the synthesis of organic compounds and complex molecular transformations.

IV. Critical Thinking:

13. The properties and manufacturing processes of industrial and advanced materials to innovate and improve existing technologies.
14. The environmental and safety impacts of various materials and pharmaceuticals, and develop strategies to mitigate these impacts.
15. Sustainable solutions using green chemistry principles to minimize toxicity and environmental impact.

16. Applications of advanced materials and develop strategies for water quality management and pollution control.
17. Reaction mechanisms and develop novel synthetic routes for organic compounds, considering practical implications.

Course Outcomes:

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

I. Understand Core Concepts:

- CO1. Gain comprehensive knowledge of industrial materials (refractories, abrasives, glass, ceramics, cement, paints, varnishes, fuels, explosives, and propellants) focusing on properties, classifications, manufacturing processes, and applications.
- CO2. Learn the principles of pharmaceutical chemistry, including drug classification, synthesis, and mechanisms of action.
- CO3. Comprehend the fundamentals of green chemistry, emphasizing atom economy, reducing toxicity, and using green solvents.
- CO4. Develop a deep understanding of advanced materials (nanomaterials, conducting polymers, superconductors), including their properties, preparation methods, and applications.
- CO5. Grasp the nomenclature, reactivity, and reaction mechanisms of organic compounds, including aldehydes, ketones, carboxylic acids, their derivatives, tautomerism, enolate chemistry, and organic rearrangements.

II. Showcase Analytical Skills:

- CO6. Analyze the properties and suitability of various industrial and advanced materials for specific applications.
- CO7. Evaluate the calorific value of fuels, significance of octane numbers, and the chemical structures and mechanisms of pharmaceuticals.
- CO8. Assess the environmental and safety impacts of industrial materials, fuels, pharmaceuticals, and advanced materials.
- CO9. Evaluate water quality using standard analytical methods and analyze reaction mechanisms involving carbonyl compounds, carboxylic acid derivatives, tautomers, and enolates.

III. Possess Practical Applications:

- CO10. Apply knowledge of industrial and advanced materials, and water purification technologies in practical and industrial contexts, ensuring safety and efficiency.
- CO11. Synthesize key pharmaceuticals and apply green chemistry principles to optimize chemical processes.
- CO12. Utilize knowledge of organic chemistry (carbonyl compounds, carboxylic acid derivatives, tautomerism, and enolate chemistry) in the synthesis of organic compounds and complex molecular transformations.

IV. Develop Critical Thinking

- CO13. Critically evaluate the properties and manufacturing processes of industrial and advanced materials to innovate and improve existing technologies.
- CO14. Assess the environmental and safety impacts of various materials and pharmaceuticals, and develop strategies to mitigate these impacts.
- CO15. Develop sustainable solutions using green chemistry principles to minimize toxicity and environmental impact.
- CO16. Innovate applications of advanced materials and develop strategies for water quality management and pollution control.
- CO17.Evaluate reaction mechanisms and develop novel synthetic routes for organic compounds, considering practical implications.

CO No.	Course outcomes statement	Knowledge level
1.	Gain comprehensive knowledge of industrial materials (refractories, abrasives, glass, ceramics, cement, paints, varnishes, fuels, explosives, and propellants) focusing on properties, classifications, manufacturing processes, and applications.	K1, K2, K3
2.	Learn the principles of pharmaceutical chemistry, including drug classification, synthesis, and mechanisms of action.	K1, K2, K3, K4
3.	Comprehend the fundamentals of green chemistry, emphasizing atom economy, reducing toxicity, and using green solvents.	K1, K2, K3, K4, K5, K6
4.	Develop a deep understanding of advanced materials (nanomaterials, conducting polymers, superconductors), including their properties, preparation methods, and applications.	K1, K2, K3, K4, K5, K6
5.	Grasp the nomenclature, reactivity, and reaction mechanisms of organic compounds, including aldehydes, ketones, carboxylic acids, their derivatives, tautomerism, enolate chemistry, and organic rearrangements.	K2, K3
6.	Analyze the properties and suitability of various industrial and advanced materials for specific applications.	K3, K4 & K5
7.	Evaluate the calorific value of fuels and significance of octane numbers.	K2, K3
8.	Assess the environmental and safety impacts of industrial materials, fuels, pharmaceuticals, and advanced materials.	K3, K4 & K5
9.	Evaluate water quality using standard analytical methods and analyze reaction mechanisms involving carbonyl compounds, carboxylic acid derivatives, tautomers, and enolates.	K1, K2, K3, K4 & K5
10.	Apply knowledge of industrial and advanced materials, and water purification technologies in practical and industrial contexts, ensuring safety and efficiency.	K3
11.	Synthesize key pharmaceuticals and apply green chemistry principles to optimize chemical processes.	K4, K5 and K6
12.	Utilize knowledge of organic chemistry (carbonyl compounds, carboxylic acid derivatives, tautomerism, and enolate chemistry) in the synthesis of organic compounds and complex molecular transformations.	K5

13.	Critically evaluate the properties and manufacturing processes of industrial and advanced materials to innovate and improve existing technologies.	K3, K4, K5 and K6
14.	Assess the environmental and safety impacts of various materials and pharmaceuticals, and develop strategies to mitigate these impacts.	K3, K4, K5 and K6
15.	Develop sustainable solutions using green chemistry principles to minimize toxicity and environmental impact.	K3, K4, K5 and K6
16.	Innovate applications of advanced materials and develop strategies for water quality management and pollution control.	K3, K4, K5 and K6
17.	Evaluate reaction mechanisms and develop novel synthetic routes for organic compounds, considering practical implications.	K3, K4, K5 and K6

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analyze, K5 – Evaluate, K6 – Create

Mapping of COs with POs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	✓	✓		✓						✓
CO 2	✓	✓		✓						✓
CO 3	✓	✓	✓	✓					✓	✓
CO 4	✓	✓	✓	✓						✓
CO 5	✓	✓		✓						✓
CO 6	✓	✓		✓						✓
CO 7	✓	✓		✓	✓					✓
CO 8	✓	✓		✓						✓
CO 9	✓	✓		✓				✓		✓
CO 10	✓	✓	✓	✓					✓	✓
CO 11	✓	✓	✓	✓	✓	✓	✓			✓
CO 12	✓	✓		✓		✓	✓			✓
CO 13	✓	✓	✓	✓		✓	✓			✓
CO 14	✓	✓	✓			✓	✓	✓		
CO 15	✓	✓	✓			✓	✓	✓		
CO 16	✓	✓	✓			✓	✓	✓		
CO 17	✓	✓	✓			✓	✓			

Programme Objectives aligned with Graduate attributes

PO1- Knowledge
PO2- Scientific thinking
PO3- Entrepreneurial skills
PO4- Analytical skills
PO5- Communication skills
PO6- Social commitment
PO7- Research and Inquiry
PO8- Conservation of Environment
PO9- Employability
PO10- Academic orientation

Syllabus

Unit I **15 Hours**

Chapter 1: Industrial materials I **5 Hours**

Refractories: Definition. Properties of a good refractory, classification, determination of PCE values. Abrasives: Definition and classification with examples, applications, hardness-definition and magnitude of hardness, manufacture and importance of carborundum and tungsten carbide. Glass: Properties, types, manufacture of soda glass. Composition and applications of borosilicate, metallic glass, optical and polycarbonate glass, safety glass, fire and bulletproof glasses. Ceramics: Raw materials and their roles, varieties of clay, production of ceramic ware, glazing, ceramic insulators. Cement: Raw materials, manufacture of Portland cement, setting of cement, role of water and gypsum.

Chapter 2: Industrial materials II **5 Hours**

Paints and Varnishes: Constituents of oil and emulsion paints and their role. Constituents of varnishes. Fuels: Characteristics, calorific value - definition and its determination using bomb calorimeter. Coal – varieties. Gaseous fuels- advantages, constituents and their significance. Production of Coal gas. Composition of LPG. Octane number definition and significance. Explosives: Classification, preparation of dynamite and TNT. Propellants: Characteristics, classification and their applications.

Chapter 3: Pharmaceutical Chemistry **3 Hours**

Chemotherapy. Drugs: classification of drugs (i) drugs used for the treatment of diseases due to infection (antimalarial, sulpha drugs, antibiotics and antiseptic drugs with examples) (ii) drugs used for the treatment of diseases not due to infection (antipyretics, analgesics, anesthetics, tranquilisers and hypnotics, narcotics, anticonvulsants, cardiac or cardiovascular and diuretics drugs with examples). Synthesis of (i) aspirin (from phenol), (ii), paracetamol (from phenol), (iii) chloropheniramine, (iv) sulphanilamide (from acetanilide). Structure and uses of (i) Penicillin and (ii) cephalosporin.

Chapter 4: Green Chemistry **2 Hours**

Introduction. Principles of Green chemistry with examples - special emphasis on atom economy, reducing toxicity and green solvents. Green chemistry and catalysis (taking the synthesis of ibuprofen as an example).

Unit II **15 Hours**

Chapter 5: Chemistry of Materials **11 Hours**

5.1: Nanomaterials

Introduction - nanostructures – types with examples. Properties - size, shape, specific surface area, crystallinity, solubility and surface morphology; special properties attributed to materials with nano-size. Preparation of gold and silver nanoparticles, definition and synthesis methods of self-assembled nanostructures. Carbon nanotubes and inorganic nanowires. Quantum dots – quantum confinement.

5.2: Conducting polymers

Introduction, definition and examples- polyaniline, polyacetylene. Mechanism of conduction. Qualitative treatment of doping. Properties: elasticity with high electrical conductivities. Engineering and biological applications.

5.3: Superconductors

Introduction, definition, type-I, type-II and atypical. Preparation of high-temperature superconductor- $Y_1Ba_2Cu_3O_{x\pm\delta}$. BCS theory (qualitative treatment only) and general applications of high-temperature superconductors.

Self-study: Fullerenes: Introduction, definition, preparation and isolation of C_{60}. Structure and chemical reactions (redox reactions, electrophilic aromatic substitution and bromination) of C_{60}. Commercial uses of C_{60}.

Chapter 6: Water Analysis and Technology **4 Hours**

Dissolved oxygen - importance, effect of temperature and determination by Winkler's method. Biochemical oxygen demand - definition, importance and permissible limits, procedure for determination using DO values. Chemical oxygen demand - definition, permissible limits for drinking water and industrial effluents, determination using $KMnO_4$ Water Purification technology: Reverse osmosis and UV filtration.

Unit III **15 Hours**

Chapter 7: Aldehydes and Ketones **6 Hours**

Review: Nomenclature of carbonyl compounds, nucleophilic addition across C=O, relative reactivity of aldehydes and ketones towards nucleophilic addition.

Addition reactions - acetal formation with mechanism. Condensation reactions - acidity of alpha hydrogen, aldol reaction with mechanism, reaction with ammonia and its derivatives to form imine, oxime, hydrozone, phenyl hydrazone and semicarbazide, Claisen, Knovenegel and Benzoin condensation. Disproportionation reaction - Cannizarro reaction with mechanism. Reduction reactions - reduction by NaBH4, LiAlH4, Wolff-kischener and Clemmenson reductions.

Chapter 8: Carboxylic Acids and thier Derivatives **9 Hours**

Review: Nomenclature of di- and tri-carboxylic acids.

8.1: Carboxylic acids

Action of heat on dicarboxylic acids - OMSGAP acids. Hydroxy acids Reactions of tartaric acid and citric acid – (i) action of heat and (ii) reduction with HI.

8.2: Derivatives of carboxylic acids

Reactions of acid chlorides - hydrolysis, reaction with alcohol, ammonia and lithium dialkyl cuprates. Reactions of acid anhydrides - hydrolysis, reaction with alcohol, ammonia. Reactions of amides - hydrolysis, reduction. Reactions of esters - alkaline hydrolysis, ammonolysis and alcoholysis. Relative reactivity of derivatives.

8.3: Mechanisms of ester hydrolysis

Acid and base catalysed (acyl O-cleavage: $B_{AC}2$, $A_{AC}2$; alkyl O-cleavage: $A_{AL}1$ mechanisms).

Unit IV **15 Hours**

Chapter 9: Tautomerism and Enolates **8 Hours**

Tautomerism in carbonyl compounds – keto-enol tautomerism; oxime-nitroso tautomerism. Acidity of α-hydrogen atoms in aldehydes, ketones, and active methylene compounds (diethyl malonate, ethyl acetoacetate, and acetylacetone). Preparation of diethyl malonate from acetic acid and synthetic applications of diethyl malonate (preparation of monocarboxylic acids - butanoic acid, dicarboxylic acid - adipic acid, unsaturated acids: cinnamic- and crotonic- acids; ketones - butanone, cyclic compounds - barbituric acid). Preparation of ethyl acetoacetate (from ethyl acetate). Synthetic applications of ethyl acetoacetate (preparation of monocarboxylic acids - butanoic acid; dicarboxylic acid - succinic acid, unsaturated acids- crotonic acid and cinnamic acid, ketones - butanone).

Chapter 10: Rearrangements **7 Hours**

Mechanisms of: Wagner - Meerwein, Fries, Beckmann, Hoffmann, benzil - benzilic acid, Favorskii rearrangements and Baeyer - Villiger oxidation.

References and Recommended Books

1. Heaton C. A., An Introduction to Industrial Chemistry, Springer Science and Business Media, 1996.
2. Vandana M, A text book of Industrial Chemistry, Educational Publisher and Distributor, 2017.
3. Sharma B. K., Industrial Chemistry Part-1, Krishna Prakashan, 2023.
4. Felder R. M., Rosseau R. W., Elementary Principles of Chemical processes, Wiley Publishers, New Delhi.
5. Kingery W. D., Bowen H. K., Uhlmann D. R., Introduction to Ceramics, Wiley publishers, New Delhi.
6. Geoffrey A. O, Andre C. A, Ludovico C, Chad A. M, Nano chemistry: A Chemical Approach to Nanomaterials,
   2nd Edition, Royal Society of Chemistry, 2003.
7. Charles P. P, Frank J O, Introduction to Nanotechnology, Wiley-Interscience, 2008.
8. Pradeep T., Text book of Nanoscience and Nanotechnology, McGraw Hill Education, 2017.
9. Poore, C.P. & Owens, F.J. Introduction to Nanotechnology John Wiley & sons, 2003.
10. Ahluwalia V K, Green Chemistry: Environmetally Benign Reactions, 3rd Edition, Springer. 2021 Carey F A, Sundberg R J, Advanced Organic Chemistry, Part A: Structure and mechanisms, 5th Edition, Springer (India) Pvt Ltd. New Delhi, 2007.
11. Carey F A, Sundberg R J, Advanced Organic Chemistry, Part B: Structure and Mechanisms, 5th Edition, Springer (India) Pvt Ltd. New Delhi, 2007.
12. Finar, I.L. Organic Chemistry (Vol. I & II), E.L.B.S. • Morrison, R.T. & Boyd, R.N. Organic Chemistry, Pearson, 2010.
13. Graham Solomon, T.W., Fryhle, C.B. & Dnyder, S.A. Organic Chemistry, John Wiley & Sons, 2014.
14. McMurry, J.E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning India Edition, 2013.
15. Sykes, P. A Guidebook to Mechanism in Organic Chemistry, Orient Longman, New Delhi, 1988.
16. Nasipuri D, Stereochemistry of Carbon Compounds, 2nd Edition, New-Age International Publishers, New Delhi, 1996.
17. Bruckner R, Organic Mechanisms - Reactions, Stereochemistry and Synthesis, Springer Verlag, Berlin, Heidelberg, 2010.
18. Clayden J, Greeves N, and Warren S, Organic Chemistry, 2nd Edition, Oxford University Press, New York, 2012.
19. Smith M B, and March J, March's Advanced Organic Chemistry, 6th Edition, John-Wiley and Sons, New York, 2007.
20. Understanding Organic Reaction Mechanisms A. Jacobs, Cambridge Univ Press, 1998.
21. Organic Chemistry M. K. Jain, Nagin & Co., 1987.
22. A Guide to Mechanism in Organic Chemistry P. Sykes, Orient Longman, 2005.

Chemistry Practical Paper VII: Advanced Inorganic and Organic Chemistry II
CREDITS:2 **NO. OF HOURS PER WEEK: 4**
COURSE CODE: 21VICH7P

Course Objectives:

This course aims to impart to the student mastery over

- Preparation of solutions required for an experiment.
- The various techniques involved in the titrimetric estimation of metal ion in their given solution and organic compounds.
- The principles of preparation of Organic compounds.

Specific Course Outcomes:

On completion of the course, students should be able to:

- Prepare reagents required for analysis
- Design a scheme for titrimetric estimation of inorganic and organic compounds and execute it based on the principles learned.
- Solve problems encountered during a synthesis.
- Communicate the results of the experiment in a written and oral form.
- Carry out quantitative tests and estimate metal ion in the given mixture.

Part A: Inorganic Chemistry

1. Titrimetric estimation of Zinc by EDTA.
2. Titrimetric estimation of Nickel by EDTA.
3. Titrimetric estimation of Calcium in limestone.
4. Titrimetric estimation of Copper in brass.
5. Titrimetric estimation of Iron in Haematite.
6. Titrimetric estimation of Ca and Mg in Dolomite.
7. Titrimetric estimation of Cu in a mixture of Ni and Cu.
8. Gravimetric estimation of Ni in a mixture of Ni and Cu.

Part B: Organic Chemistry

1. Cannizarro Reaction – preparation of benzoic acid from benzaldehyde
2. Sandemayer Reaction – preparation of 4-chlorotoluene from 4-toluidine
3. Titrimetric estimation of amino acids
4. Estimation of glucose by Fehling's method
5. Saponification value of oil
6. Iodine value of oil by Chloramine T method
7. Estimation of keto group
8. Estimation of phenol

References and Recommended Books:

1. Vogel's text book of Quantitative Chemical Analysis, 5th Edition, J. Bassett, G. H. Jeffery and J. Mendham, and R. C. Denny, Longman Scientific and Technical (1999).
2. Practical Inorganic Chemistry, G. Marr and B. W. Rockett, Von Nostrand Reinhold Co., London (1972).
3. Laboratory manual of Organic Chemistry- B. B. Dey, M V Sitaraman and T R Govindachari, Allied Publishers, New Delhi, (1996).
4. Practical Organic Chemistry - Mann and Saunders, (1980).
5. Textbook of Practical Organic Chemistry- A. I. Vogel, (1996).
6. Textbook of Quantitative Organic Analysis- A. I. Vogel, (1996).
7. A Handbook of Organic Analysis - Clarke and Hayes, (1964).
8. Comprehensive practical organic chemistry: Preparation and quantitative Analysis,
9. V. K. Ahluwalia, R. Aggarwal, Universities Press (India), 2000.

10. Comprehensive practical organic chemistry: Qualitative analysis, V.K. Ahluwalia, S. Dhingra, Universities Press (India), 2000.
11. An advanced course in practical chemistry, A. Ghoshal, B. Mahapatra and A. Kr. Nad, New central book agency, Calcutta, 2000.
12. Advanced practical organic chemistry, J. Mohan, Vol. I and II, Himalaya Publishing House, 1992.
13. Practical organic chemistry (Quantitative analysis), B. B. Dey, M. V. Sitaraman and T. R. Govindachari, Allied Publishers, New Delhi, 1992.

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JYOTI NIVAS COLLEGE AUTONOMOUS, BANGALORE- 560095
III B.Sc., VI Semester, 21VICH7T
Chemistry VII
Advanced Inorganic and Organic Chemistry II

End Semester Question Paper Format for Theory

Maximum Marks: **60** Time: **2 Hrs 30 mins**

The question paper shall have **Sections A**, **B** and **C**. **Section A** shall consist of **9** questions of **2** marks each of which the student answers **5** questions. **Section B** shall consist of **8** questions of **4** marks each of which the student answers **5** questions. **Section C** shall consist of **4** questions of **10 (can be split as 5+5 and 6+4)** marks of which the student answers **3** questions to give due weightage to all chapters. The question paper shall consist of questions drawn from the respective chapters such that the marks allotted to these chapters are in proportion to the number of teaching hours prescribed. **Paper setters are requested to avoid 2 marks questions in Section B.**

Blue print of Question Paper

Unit	Chapter Title	Hours of Teaching	Marks Allotted
I	Chapter 1: Industrial materials I Chapter 2: Industrial materials II Chapter 3: Pharmaceutical Chemistry Chapter 4: Green Chemistry	15 (5+5+3+2)	23 (8+8+4+3)
II	Chapter 5: Chemistry of Materials (Nanomaterials, Conducting Polymers and Superconductors)	15 (11+4)	22 (16+6)

	Chapter 6: Water Analysis and Technology		
III	Chapter 7: Aldehydes and Ketones Chapter 8: Carboxylic Acids and their derivatives (Carboxylic acids, Derivatives of Carboxylic acids and Mechanism of ester hydrolysis	15 (6+9)	22 (8+14)
IV	Chapter 9: Tautomerism and Enolates Chapter 10: Rearrangements	15 (8+7)	23 (13+10)
Total		**60**	**Sec A: 9 x 2 = 18** **Sec B: 8 x 4 = 32** **Sec C: 4 x 10 = 40** **Total = 90**
Max. Marks for students: 60 (A: 5 x 2=10 + B: 5 x 4 = 20 + C: 3 x 10 = 30)			

JYOTI NIVAS COLLEGE AUTONOMOUS, BANGALORE- 560095
III B.Sc., VI Semester, 21VICH7T
Chemistry VII
Advanced Inorganic and Organic Chemistry II
Model Question Paper

Time: 2:30 Hrs. **Max. Marks: 60**

Section A

Answer any five of the following questions. **(5 x 2 = 10)**

1. Write the equation for the manufacture of tungsten carbide.
2. Mention any two advantages of gaseous fuels.
3. Give any two examples of green solvents.
4. What are conducting polymers? Give an example.
5. Define chemical oxygen demand.
6. Why are aldehydes more reactive than ketones in terms of nucleophilic addition? Give reason.
7. What happens when citric acid is treated with HI?
8. Why is the enol form of β-dicarbonyl compounds more stable?
9. What is Baeyer-Villiger oxidation?

Section B

Answer any five of the following questions. **(5 x 4 = 20)**

10. Explain the constituents of varnishes with a suitable example each.
11. How would you determine PCE (Pyrometric Cone Equivalent) of a refractory material? Explain.
12. Write the stepwise fabrication of high temperature superconductor - $YBa_2Cu_3O_{7-x}$.
13. How do you determine the amount of dissolved oxygen using Wrinkler's method?
14. Give the mechanism of Cannizarro's reaction.
15. How is an acid anhydride prepared from its corresponding acid? Give the reaction of an acid anhydride with (i) water, (ii) alcohol and (iii) ammonia.
16. Explain the malonic ester synthesis of hexanoic acid.
17. Give the mechanism of Beckmann rearrangement.

Section C

Answer any three of the following questions. **(3 x 10 = 30)**

18. a) Describe the manufacture of soda glass.
    b) Draw the general structure of Penicillin and mention its uses. **(5+5)**

19. a) Discuss the properties of carbon nanotubes, carbon nanowires and quantum dots.
    b) Write the synthesis of polyacetylene using Ziegler-Natta catalyst and state its applications.

(5+5)

20. a) Explain Blanc's rule in detail.
    b) Give the two mechanisms for acyl-O cleavage of esters in acidic and basic conditions and compare the two processes of hydrolysis. **(5+5)**

21. a) How will you prepare the following from acetoacetic ester? (i) butanoic acid, (ii) succinic acid, (iii) crotonic acid, (iv) cinnamic acid and (v) butanone.
    b) Give the mechanism of the reaction used to convert benzil to benzilic acid. **(5+5)**

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