DEPARTMENT OF CHEMISTRY

GOVT. DIGVIJAY PG AUTONOMOUS COLLEGE, RAJNANDGAON (C.G.)

B.Sc.

Major - Chemistry

Fifth Semester

2025-26

DEPARTMENT OF CHEMISTRY

GOVT. DIGVIJAY PG AUTONOMOUS COLLEGE, RAJNANDGAON

Syllabus and Marking Scheme for

B.Sc. (Honours)

Major - Chemistry

Session 2025-26

Fifth & Sixth Semester

Paper	Title of the Paper	Credit	Marks (ESE + IA)	Total Marks
Fifth Semester				
DSC 5	Inorganic Chemistry-II	3	80 + 20	100
DSC 5 LAB	Inorganic Chemistry-II Lab	1	40 + 10	50
DSE 5A	Heterocyclic Chemistry	3	80 + 20	100
DSE 5A LAB	Heterocyclic Chemistry Lab	1	40 + 10	50
DSE 5B	Polymer Chemistry	3	80 + 20	100
DSE 5B Lab	Polymer Chemistry Lab	1	40 + 10	50
SEC	Green Methods in Chemistry-I	2	40 + 10	50
Sixth Semester				
DSC 6	Physical ChemistryII-	3	80 + 20	100
DSC 6 LAB	Physical ChemistryII- Lab	1	40 + 10	50
DSE 6A	An Introduction to Spectroscopy: Principles and Applications	4	80 + 20	100
DSE 6B	Elementary Quantum Mechanics and Photochemistry	4	80 + 20	100
SEC	Green Methods in Chemistry-I (Project Based)	2	40 + 10	50

DEPARTMENT OF CHEMISTRY

GOVT. DIGVIJAY PG AUTONOMOUS COLLEGE, RAJNANDGAON

Syllabus and Marking Scheme for

B.Sc.

Major - Chemistry

Fifth Semester

Session 2025-26

Paper	Title of the Paper	Credit	Marks (ESE + IA)	Total Marks
DSC5	Inorganic Chemistry-II	3	80 + 20	100
DSC5 LAB	Inorganic Chemistry-II Lab	1	40 + 10	50
DSE-I	Heterocyclic Chemistry	3	80 + 20	100
DSE-II LAB	Heterocyclic Chemistry Lab	1	40 + 10	50
DSE-II	Polymer Chemistry	3	80 + 20	100
DSE-II Lab	Polymer Chemistry Lab	1	40 + 10	50
SEC	Green Methods in Chemistry-I	2	40 + 10	50

GOVT. DIGVIJAY AUTONOMOUS P.G. COLLEGE, RAJNANDGAON (C.G.)

Four Year UnderGraduate Programme (FYUGP) Session 2025-26

Major - Chemistry

Session: 2025-26	Program: B.Sc.
Semester: V	Subject: Chemistry
Course Type: DSC 5	Course Code:
Course Title:	**Inorganic Chemistry-II**
Credit: 03	Lecture: 60
M.M. : 100 = (ESE 80+IA 20)	Minimum Passing Marks: 40

Title	Inorganic Chemistry-II
Course Objectives	Students will have a basic knowledge of liquid state, ionic equilibria, concept of acid-base and non-aqueous solvents.
Learning Outcomes	**Unit 1-** Students will develop an understanding about the Oxidation and reduction and nuclear chemistry. **Unit 2 -** Students will have an insight look about Lanthanides and actinides. **Unit 3-** Students will have an insight about the Organometallic chemistry. **Unit 4 -** Students will understand about the catalysis reactions of organometallic compounds and bioinorganic chemistry.

Units	Lectures	Topics
I	15	**A. Oxidation and Reduction** Redox potential, balancing redox reactions, Latimer's law. Frost Latimer and Pourbaix diagram principles involving extraction of the elements. **B. Nuclear chemistry**: nuclear reactions, fission and fusion, radio-analytical techniques and activation analysis
II	15	**Chemistry of Inner Transition Metals** **Chemistry of Lanthanides** Electronic structure, oxidation states and ionic radii and lanthanide contraction, complex formation, occurrence and isolation, lanthanide compounds. **Chemistry of Actinides** General features and chemistry of actinides, chemistry of separation of Np, Pu and Am from uranium, similarities between the later actinides and the later lanthanides.
III	15	**Organometallic Chemistry**

		Definition and classification of organometallic compounds on the basis of bond type. Concept of hapticity of organic ligands. Metal carbonyls: 18-electron rule, electron count of mononuclear, polynuclear and substituted metal carbonyls of 3d series. General methods of preparation (direct combination, reductive carbonylation, thermal and photochemical decomposition) of mono and binuclear carbonyls of 3d series. Structures of mononuclear and binuclear carbonyls of Cr, Mn, Fe, Co and Ni using VBT. π- acceptor behavior of CO (MO diagram of CO to be discussed), Zeise's salt: Preparation and structure.
IV	15	**A. Catalysis by Organometallic compounds**: Alkene hydrogenation (Wilkinsons Catalyst) and Polymeration of ethane using Ziegler – Natta Catalyst **B. Bio-Inorganic Chemistry** Essential and trace elements in biological processes, Excess and deficiency of some trace metals, Toxicity of some metal ions (Hg, Pb, Cd and As), metalloporphyrins with special reference to hemoglobin and myoglobin. Biological role of alkali and alkaline earth metals with special reference to Ca^{2+} and Mg^{2+}, nitrogen fixation.

List of Books	• J. D. Lee: A new Concise Inorganic Chemistry, E L. B. S. • F. A. Cotton & G. Wilkinson: Basic Inorganic Chemistry, John Wiley. • Douglas, McDaniel and Alexader: Concepts and Models in Inorganic Chemistry, John Wiley. • G. M. Barrow: Physical Chemistry Tata McGraw-Hill (2007). • G. W. Castellan: Physical Chemistry 4th Edn. Narosa (2004). • C. Kotz, P. M. Treichel& J. R. Townsend: General Chemistry CengageLening India Pvt. Ltd., New Delhi (2009). • H. Mahan: University Chemistry 3rd Ed. Narosa (1998). • R. H. Petrucci: General Chemistry 5th Ed. Macmillan Publishing Co.: New York (1985). • F. Shriver and P. W. Atkins: Inorganic Chemistry, Oxford University Press. • Gary Wulfsberg: Inorganic Chemistry, Viva Books Pvt. Ltd.

Inorganic Chemistry-II Lab

Session: 2025-26	Program: B.Sc.
Semester:	Subject: Chemistry
Course type: DSC5L AB	Course Code:
Course Title :	**Inorganic Chemistry-II Lab**
MM: 50 (40 + 10)	Minimum Passing Marks: 20
Credit: 2	

List of Practicals

Volumetric analysis

(a) Determination of acetic acid in commercial vinegar using NaOH.
(b) Determination of alkali content-antacid tablet using HCl.
(c) Estimation of calcium content in chalk as calcium oxalate by permanganometry.
(d) Estimation of hardness of water by EDTA.
(e) Estimation of ferrous & ferric by dichromate method.
(f) Estimation of copper using thiosulphate.

Chromatographic analysis:

Principle involved in chromatographic separations. Paper chromatographic separation of following metal ions: i. Ni (II) and Co (II) ii. Fe (III) and Al (III)

Gravimetric analysis:

a) Estimation of nickel (II) using Dimethylglyoxime (DMG).
b) Estimation of copper as CuSCN
c) Estimation of iron as Fe_2O_3 by precipitating iron as $Fe(OH)_3$.
d) Estimation of Al (III) by precipitating with oxine and weighing as $Al(oxine)_3$ (aluminium - oxinate).
e) Estimation of Barium as $BaSO_4$

List of Books

- Vogels Qualitative Inorganic Analysis, A.I. Vogel, Prentice Hall, 7th Edition.
- Vogels Quantitative Chemical Analysis, A.I. Vogel, Prentice Hall, 6th Edition.
- Mendham, J., A. I. Vogel's Quantitative Chemical Analysis Sixth Edition, Pearson, 2009.
- Svehala G. and Sivasankar I. B, Vogel's Qualitative Inorganic Analysis, Pearson, India, 2012

GOVT. DIGVIJAY AUTONOMOUS P.G. COLLEGE, RAJNANDGAON (C.G.)

B. SC. (Multiple Major) - DIPLOMA COURSE (session 2025-26)

Major - Chemistry

Heterocyclic Chemistry	
Session: **2025-26**	Program: B.Sc.
Semester: V	Subject: Chemistry
Course Type: DSE 5A	Course Code:
Course Title:	**Heterocyclic Chemistry**
Credit: 03	Lecture: 60
M.M. : 100 = (ESE 80 + IA 20)	Minimum Passing Marks: 40%

Title	**Heterocyclic Chemistry**
Course Objectives	Students will have a basic knowledge of Three-membered heterocycles, Four-membered heterocycles, Five-membered aromatic heterocycles, Condensed five-membered Heterocycles.
Learning Outcomes	**Unit 1-** Students will develop an understanding about the Three-membered heterocycles. **Unit 2 -** Students will have an insight look about Four-membered heterocycles. **Unit 3-** Students will have an insight comparative study of Five-membered aromatic heterocycles. **Unit 4 -** Students will understand about Condensed five-membered heterocycles.

Unit	**Lectures**	**Content**
I	**15**	Introduction, structure and systematic nomenclature of heterocyclic compounds **Three-membered rings** with one heteroatom: Chemistry of oxiranes, aziridines and episulphides - synthetic approaches and reactivities. **Three-membered heterocycles** with two heteroatoms: oxaziranes, diaziridines and diazirines - synthetic approaches and reactivities.
II	**15**	**Four-membered heterocycles**: oxitanes, azatidanes and thietanes - synthetic approaches and reactivities. natural products:synthesis of

		Peniciline and cephalosporine.
III	15	**Five-membered aromatic heterocycles:** 1. With one heteroatom: furans, pyrroles and thiophenes - general synthetic approaches, properties and reactivities. 2. With two heteroatoms: oxazoles, isoxazoles, imidazoles, thiazoles, pyrazoles and isothiazoles - general synthetic approaches and reactivities. 3. With three and four heteroatoms: triazoles and tetrazoles - synthetic approaches, properties and reactivity.
IV	15	**Condensed five-membered Heterocycles:** Benzofuran, indoles and benzothiazoles - general synthetic approaches, with greater emphasis on the chemistry of Indoles

List of Books	• Heterocyclic Chemistry, J.A. Joule, K. Mills, Wiley, 2010. • The Essence of heterocyclic Chemistry, A. R. Parikh, H. Parikh, R. Khunt, New Age Int. Publication, • Principles of Modern Heterocyclic Chemistry, L. A. Paquette, W. A. Benjamin, New York, 1968. • Heterocyclic Chemistry, J.A. Joule and G. F. Smith, van Nostrand, London, 1978. • Comprehensive Heterocyclic Chemistry. The structure, reactions, synthesis and use of Heterocyclic compounds, (Ed. A.R. Katritzky and C. W. Rees),. Vol 1-8, Pergamon Press, 1984. • Handbook of Heterocyclic Chemistry, A. R. Katritzky, Pergamon Press, 1985. • Van der plas, H. C. Ring transformations of Heterocycles, Vols 1 and 2, Academic Press, 1974.

Heterocyclic Chemistry Lab

Session: **2025-26**	Program: B.Sc.
Semester: V	Subject: Chemistry
Course Type: DSE LAB	Course Code:
Course Title:	**Heterocyclic Chemistry Lab**
M.M. : 50 – (40 + 10)	Minimum Passing Marks: 20
Credit : 01	

List of Practicals

1. Identification of hetero atoms (S, N, X) in given organic compounds in lab.
2. Identification separation of simple organic compounds containing hetero atoms using column chromatorgapy/TLC) in lab.
3. Spectroscopic identification of simple organic compounds (spectra may be provided to the students and teachers may help the students to identify the compounds using spectra). Melting point/boiling point of the compounds may be checked for its purity.
4. Preparation of : Indigo (using aldol condensation reaction of 2-nitrobenzaldehyde with acetone in basic condition);

   (Depending upon laboratory facilities, more preparation of heterocyclic group of compounds may be incorporated by teacher).

List of Books

- Vogels Qualitative Inorganic Analysis, A.I. Vogel, Prentice Hall, 7th Edition.
- Vogels Quantitative Chemical Analysis, A.I. Vogel, Prentice Hall, 6th Edition.
- Mendham, J., A. I. Vogel's Quantitative Chemical Analysis Sixth Edition, Pearson, 2009.
- Svehala G. and Sivasankar I. B, Vogel's Qualitative Inorganic Analysis, Pearson, India, 2012.
- T. W. Graham Solomon: Organic Chemistry, John Wiley and Sons.
- Peter Sykes: A Guide Book to Mechanism in Organic Chemistry, Orient Longman.
- E. L. Eliel: Stereochemistry of Carbon Compounds, Tata McGraw Hill. I. L. Finar: Organic Chemistry (Vol. I & II), E. L. B. S.
- R. T. Morrison & R. N. Boyd: Organic Chemistry, Prentice Hall.
- Arun Bahl and B. S. Bahl: Advanced Organic Chemistry, S. Chand.

GOVT. DIGVIJAY AUTONOMOUS P.G. COLLEGE, RAJNANDGAON (C.G.)

B. SC. (Multiple Major) - DIPLOMA COURSE (session 2025-26)

Major - Chemistry

GOVT. DIGVIJAY AUTONOMOUS P.G. COLLEGE, RAJNANDGAON (C.G.)	
Polymer Chemistry	
Session: 2025-26	**Program: B.Sc.**
Semester: V	**Subject: Polymer Chemistry**
Course type: DSE - IV (GE)	**Course Code:**
Credit: 03	**Lecture : 60**
MM: 100 (80 + 20)	Minimum Passing Marks: 40%

Title	Polymer Chemistry
Course Objectives	Students will have a basic knowledge of Polymers, Polymeric Structure and Property Relationship. Polymerization Chemistry, Polymer Processing and Polymer additives.
Learning Outcomes	**Unit 1-** Students will develop an understanding about the Polymers. **Unit 2 -** Students will have an insight look about Polymeric Structure and Property Relationship. **Unit 3-** Students will have an insight comparative study of Polymerization Chemistry. **Unit 4 -** Students will understand about Polymer Processing and Polymer additives.

Unit	Lectures	Content
I	15	**Introduction** DP Polymer, monomer, examples of polymers, biopolymers, classification, polymerization process, degree of polymerization, condensation, addition polymers, kinetics of addition polymerization process
II	15	**Polymeric Structure and Property Relationship** DP Structure of polymers - Linear, branched, cross linked, and network

12/7/25

		polymers, molecular weight (number average, weight average, viscosity average) and distribution of molecular weight, polydispersity index, crystallinity in polymer, melting temperature and glass transition temperature, Volumetric properties - molar volume, density, Van der Waals volume – Coefficient of linear thermal expansion and volumetric thermal expansion - Pressure volume temperature (PVT) relationship.
III	15	**Polymerization Chemistry** Industrial methods of polymerization such as a bulk, solution, emulsion, suspension. Stereochemistry of polymers and stereo-specific polymerization, Catalysts-their utility in polymers and stereo-specific polymerizations, Catalysts their utility in polymer manufacture, Zieglar-Natta, Metalloecene and others.
IV	15	**Polymer Processing** Plastics Thermosetting plastics, elastomers, fibres, compounding Processing techniques Calendering, diecasting, rotational casting, film casting, injection moulding, blow moulding, extrusion moulding, compression moulding, thermoforming, foaming, reinforcing, fibre spinning **Polymer additives** Types of fillers, miscellaneous mineral fillers, plasticizers, antioxidants, UV-stabilizers and absorbers, fire retardants, colourants

List of Books	• . D.W. Van Krevelen and P.J. Hoftyzen, "Properties Of Polymer, 3rd Edition Elsevier Scientific, Publishing Company Amsterdam - Oxford - Newyork. 1990. • J.E. Mark Ed. AIP, Physical Properties Of Polymers Hand Book, Williston, Vt, 1996. • Reaction Engineering of Step Growth Polymerization, S K Gupta and Anil Kumar, Plenum Press, 1987 • Odian; George, Principles of Polymerization, McGraw-Hill Book Co., New York (1970). • W. Billmeyer, Text book of polymer science, 3rd Edn., 2007, Wiley. • J.R. Fried, Polymer Science and Technology, (2005), PHI publication.

Polymer Chemistry Lab	
Session: **2025-26**	Program: B.Sc.
Semester: V	Subject: Chemistry
Course Type: DSE LAB (SB)	Course Code:
Credit: 01	Course Title: **Polymer Chemistry Lab**
M.M. : 50 = (40 + 10)	Minimum Passing Marks: 20

List of Practicals

1. Free radical solution polymerization of any one: Styrene, methylmethacrylate, methyl acrylate, methacrylic acid (using free radical initiators). (purification of monomer should be taught)
2. Preparation of phenol-formaldehyde resins
3. Emulsion polymerization of polymethylmethacrylate.
4. Use of viscometer for molecular weight determination – (any known polymer, example: polyvinyl pyrrolidone in water/polyacrylamide in $NaNO_2$ solution) by viscometry. (students should be explained regarding principles and use of ubblohde/ostwald viscometer).
5. Estimation of amount of HCHO in a given solution by sodium bisulphite method.

List of Books	• Vogels Qualitative Inorganic Analysis, A.I. Vogel, Prentice Hall, 7th Edition. • Vogels Quantitative Chemical Analysis, A.I. Vogel, Prentice Hall, 6th Edition. • Mendham, J., A. I. Vogel's Quantitative Chemical Analysis Sixth Edition, Pearson, 2009. • Svehala G. and Sivasankar I. B, Vogel's Qualitative Inorganic Analysis, Pearson, India, 2012. • T. W. Graham Solomon: Organic Chemistry, John Wiley and Sons. • Peter Sykes: A Guide Book to Mechanism in Organic Chemistry, Orient Longman. • E. L. Eliel: Stereochemistry of Carbon Compounds, Tata McGraw Hill. I. L. Finar: Organic Chemistry (Vol. I & II), E. L. B. S. • R. T. Morrison & R. N. Boyd: Organic Chemistry, Prentice Hall. • Arun Bahl and B. S. Bahl: Advanced Organic Chemistry, S. Chand.

GOVT. DIGVIJAY AUTONOMOUS P.G. COLLEGE, RAJNANDGAON (C.G.)

B. SC. (Multiple Major) - DIPLOMA COURSE (session 2024-25)

Major - Chemistry

Session: **2025-26**	Program: B.Sc.
Semester: V	Subject: Chemistry
Course Type: SEC	Course Code:
Course Title:	**Green Methods in Chemistry-I**
Credit: 2	Lecture: 30
M.M. : 50 (40 + 10)	Minimum Passing Marks: 40%

Title	Green Methods in Chemistry-I
Course Objectives	• To inspire the students about the chemistry which is good for human health and environment. • To evaluate suitable technologies for the remediation of hazardous substances. • To acquire the knowledge of the twelve principles of green chemistry and how to apply in green synthesis. • To make students aware about the benefits of using green chemistry.
Learning Outcomes	By the end of this course, students will be able to: • Think to design and develop materials and processes that reduce the use and generation of hazardous substances in industry. • Get ideas of innovative approaches to environmental and societal challenges. • Know how chemicals can have an adverse/potentially damaging effect on human and vegetation. • Critically analyse the existing traditional chemical pathways and processes and creatively think about bringing environmentally benign reformations in these protocols. • Convert biomass into valuable chemicals through green technologies.

Units	Lectures	Topics
I	8	**Introduction** Definition of green chemistry and how it is different from conventional chemistry and environmental chemistry. Need of green chemistry Importance of green chemistry in- daily life, Industries and solving human health problems (four examples each). Twelve principles of Green Chemistry Green Chemistry and Challenges Green Chemistry Awareness Initiative Green Chemistry Challenge Awards Green Chemistry in India Typical Real World Cases of Green Chemistry
II	7	**Renewable Energy Sources** Introduction Biomass Energy, types of biomass, conversion of biomass, impact on climate and environment Bio-fuels, types, biodiesel, green diesel, biogasoline, biogas, biodigesters Solar Energy, production of thermal and electrical energy, application in daily life, solar cells Wind Energy, resources, production, turbines Hydro power, harnessing the hydro power, disadvantages and limitations, applications Geothermal energy, types, geothermal wells, environmenal effects

III	8	**Prevention of Chemical Accidents** **Hazardous Chemical Symbols and Precautions** **Pecautions and first aid during Chemical Accidents** Designing greener processes Inherent safer design and its subdivision : minimization, simplification, substitution, moderation and limitation. Greener alternative to Bhopal Gas Tragedy (safer route to carcarbaryl) and Flixiborough accident (safer route to cyclohexanol)
IV	7	**Future Trends in Green Chemistry** Oxidation reagents and Catalysts Biomimetic synthesis is with examples of alkaloid tropinone and biocatalysts, multifunctional reagents Combinatorial Green Chemistry Solventless reactions, advantages and limitations, examples such as halogenation, Michael addition, Aldol condensation, Grignard reaction, Reformatsky reaction Green Chemistry in Sustainable Development

List of Books	• Anastas, P.T.; Warner, J.C.(1998), Green Chemistry, Theory and Practice, Oxford University Press. • Lancaster, M.(2016),Green Chemistry An Introductory Text.2nd Edition, RSC Publishing. • Cann , M. C.; Umile, T.P. (2008), Real world cases in Green chemistry Vol 11, American Chemical Society, Washington. • Matlack, A.S.(2001),Introduction to Green Chemistry, Marcel Dekker. • Ryan, M.A.; Tinnesand, M. (2002), Introduction to Green Chemistry (Ed), American Chemical Society, Washington DC.