Department of Chemistry and Chemical Sciences
CENTRAL UNIVERSITY OF JAMMU
Rahya-Suchani (Bagla), District-Samba,
Jammu-181143, (J&K) India

Five-year Integrated M.Sc. Chemistry
Teaching Plan (Jan 2021-July 2021)

Semester: X
Course: Green Chemistry (Elective I) (ICCHM10E001T)
Course Teacher: Dr. Princy Gupta

Week	Lecture No.	Topic to be Taught	No of Hours	Suggested Readings
1st Week	I	**Introduction to green chemistry:** Definition, Principles of green chemistry, Ideal synthesis	1	1-6
	II	E-factor, Atom economy	1	1-6
2nd Week	I	Atom economic (rearrangement and addition reactions)	1	1-6
	II	uneconomic reactions (substitution and elimination reaction)	1	1-6
3rd Week	I	Need, development and vision of green chemistry	1	1-6
	II	Advantages over conventional methods	1	1-6
4th Week	I	Modern variants in green synthesis	1	1-6
	II	Step economy	1	1-6
5th Week	I	Introduction to multicomponent reactions	1	1-6
	II	Domino reactions	1	1-6
6th Week	I	**Green synthesis/reactions**: Comparative study of conventional and green protocols of Wittig	1	1-6
	II	Comparative study of conventional and green protocols Bouveault reaction	1	1-6
7th Week	I	Comparative study of conventional and green protocols Heck reaction	1	1-6
	II	Comparative study of conventional and green protocols Michael addition	1	1-6
8th Week	I	Comparative study of conventional and green protocols Darzen	1	1-6
	II	Comparative study of conventional and green protocols Diels-Alder reaction	1	1-6
9th Week	I	Comparative study of conventional and green protocols Thiamine mediated acyloin condensation,	1	1-6
	II	Comparative study of conventional and green protocols Baeyer-Villiger oxidation	1	1-6
10th Week	I	Comparative study of conventional and green protocols Claisen rearrangement	1	1-6
	II	Comparative study of conventional and green protocols Hantzsch synthesis	1	1-6
11th Week	I	Comparative study of conventional and green protocols Ugi reaction	1	1-6

	II	Click reactions	1	1-6
12th Week	I	Combinatorial chemistry	1	1-6
	II	Green synthesis of nanoparticles	1	1-6
13th Week	I	Selected examples from US Presidential Green Chemistry Challenge Award Winners	1	1-6
	II	Contd.	1	1-6
14th Week	I	Contd.	1	1-6
	II	Contd.	1	1-6
15th Week	I	Contd.	1	1-6
	II	Revision of Unit I	1	
16th Week	I	Revision of Unit II	1	
	II	Discussion of model question papers	1	

REFERENCES

1. P. Tundo, A. Perosa and F. Zucchini, Methods and Reagents for Green Chemistry, Wiley, New Jersey, 2007.
2. M. Rai and C. Posten, Green Biosynthesis of Nanoparticles Mechanisms and Application CABI, 2013.
3. S. Matlack, Introduction to Green Chemistry, Marcel Dekker, Inc., New York, 2001.
4. A. Patt, Green Approaches to Asymmetric Catalytic Synthesis, Springer, 2011.
5. V. K. Ahluwalia, Green Chemistry: Environmentally benign reaction, Boca Raton, FL: CRC, Taylor & Francis, 2008.
6. P. T. Anastas and R. H. Crabtree, Handbook of Green Chemistry, Green Catalysis, Homogeneous Catalysis, Wiley, 2014.

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Five-year Integrated M.Sc. Chemistry

Teaching Plan (February 2021-June 2021)

Semester: X
Course: Green Chemistry
Course Teacher: Dr. Swati Sharma

Week	Lecture No./Day	Topic to be Taught	No of Hours	Suggested Readings
1st Week	I	Reactions in unconventional medium: Pollution due to solvents,	1	1-6
	II	Global effect of solvent usage,	1	1-6
2nd Week	I	Need for green solvents,	1	1-6
	II	Aqueous medium: Enhancement of selectivity,	1	1-6
3rd Week	I	efficiency,	1	1-6
	II	and industrial applicability,	1	1-6
4th Week	I	Ionic liquids,.	1	1-6
	II	Glycerol, Polyethylene glycol,	1	1-6
5th Week	I	Supercritical fluids,	1	1-6
	II	Solvent-free reactions,	1	1-6
6th Week	I	Fluorous phase reactions	1	1-6
	II	Contd.	1	1-6
7th Week	I	Heterogeneous catalysis: Introduction to green catalysis	1	1-6
	II	, Heterogeneous catalysts,	1	1-6
8th Week	I	Advantages of solid catalysts or reagents,	1	1-6
	II	Use of zeolites, silica,	1	1-6
9th	I	alumina, clay, amberlyst,	1	1-6
	II	montmorillonite, polymers,	1	1-6

Week				
10th Week	I	cyclodextrin supported catalysts,	1	1-6
	II	Solid acids, Ion exchange resins,	1	1-6
11th Week	I	Advantages of solid acids over mineral acids, Supported metal oxides,	1	1-6
	II	Rare earth triflates,.	1	1-6
12th Week	I	Physisorbed and Chemisorbed solid acid catalysis,	1	1-6
	II	Biocatalysts, Baker's yeast	1	1-6
13th Week	I	Nonconventional energy sources: Microwave assisted reactions,	1	1-6
	II	advantage of microwave exposure,	1	1-6
14th Week	I	specific effects of microwaves,	1	1-6
	II	selected microwave-assisted condensations reactions,	1	1-6
15th Week	I	oxidations, reductions reactions and multicomponent reactions,.	1	1-6
	II	Ultrasound assisted reactions,	1	1-6
16th Week	I	Ball milling,	1	1-6
	II	Continuous flow reactor,	1	1-6
17th Week	I	Photochemical reactions	1	1-6
	II	Contd.	1	1-6

REFERENCES

1.P. Tundo, A. Perosa and F. Zucchini, *Methods and Reagents for Green Chemistry*, Wiley, New Jersey, 2007.
2. M. Rai and C. Posten, *Green Biosynthesis of Nanoparticles Mechanisms and Application* CABI, 2013.
3. A. S. Matlack, *Introduction to Green Chemistry*, Marcel Dekker, Inc., New York, 2001.
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5. V. K. Ahluwalia, *Green Chemistry: Environmentally benign reaction*, Boca Raton, FL: CRC, Taylor & Francis, 2008.
6. P. T. Anastas and R. H. Crabtree, *Handbook of Green Chemistry, Green Catalysis, Homogeneous Catalysis*, Wiley, 2014.

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Five-Year Integrated M.Sc Chemistry
Teaching Plan (February, 2021- June, 2021)

Semester: X
Course: Organometallic Chemistry-Elective-III (ICCHM10E003T)
Course Teacher: Dr. Mousumi Pal

Week	Lecture No/Day	Topic to be taught	No of Hour	Suggested Reading
1st Week	I	Introduction to reaction mechanism and catalysis: Homogeneous catalysis: Introduction	1	1-5, 14
	II	Properties of catalysis,	1	1-5, 14
2nd Week	I	Types of reactions in homogeneous catalysis (Oxidative addition, Reductive elimination)	1	1-3,5-11, 14
	II	…Insertion, Hydride elimination, Abstraction	1	1-3,5-11, 14
3rd Week	I	Hydroformylation, Hydrogenation of olefin,	1	1-3,5-11, 14
	II	Isomerisation of olefin	1	1-3,5-11, 14
4th Week	I	Oxo process, Wacker process	1	1-3,5-11, 14
	II	Monsanto acetic acid synthesis, Monsanto L-Dopa synthesis,	1	1-3,5-11, 14
5th Week	I	Water gas shift reaction, Carbonylation,	1	1-3,5-11, 14
	II	Template synthesis	1	1-3,5-11, 14
6th Week	I	Alkene hydrosilation.	1	1-3,5-11, 14
	II	Heterogeneous catalysis: Introduction,	1	12,13
7th Week	I	Fischer Tropsch reaction,	1	12,13
	II	Ziegler-Natta catalysis	1	12,13
8th Week	I	Basic concept on Fluxional Organometallic Compounds Fluxionality and dynamic equilibria in compounds such as η^2-olefin,	1	5-11
	II	η^3-allyl and dienylcomplexes	1	5-11
9th Week	I	Non-rigid molecules in different coordination geometry,	1	5-11
	II	Fluxional molecule, σ-bonded ligand.	1	5-11

10th Week	**I**	Transition metal compounds with bonds to hydrogen: Chemistry of transition metal compounds with bonds to hydrogen: Types	1	1, 5-11
	II	Contd.……Synthesis and chemical reaction	1	1, 5-11
11th Week	**I**	Aluminohydrides	1	1, 5-11
	II	borohydrides,	1	1, 5-11
12th Week	**I**	C-N bond coupling reaction	1	1, 5-11
	II	Asymmetric hydrogenation	1	1, 5-11
13th Week	**I**	Introduction of Biological application and environmental aspects of organometallic compounds,	1	6, 7, 15
	II	organometallics in medicine and agriculture	1	6, 7, 15
14th Week	**I**	organometallics in horticulture and environmental aspects.	1	6, 7, 15
	II	Concept on Application of organometallics in organic synthesis: C-C coupling reaction (Heck reaction)	1	1, 4, 9
15th Week	**I**	Sonogoshira, Suzuki reactions etc.)	1	1, 4, 9
	II	Contd.	1	

References:

1. F. A. Cotton, G. Wilkinson, *Inorganic Chemistry*, 5th Ed., Wiley, 1988.
2. R. H. Crabtree, *The Organometallic Chemistry of the Transition Metals*, 7th Ed., Wiley, 2019.
3. P. Powell, *Principles of Organometallic Chemistry*, 2nd Ed., ELBS, 1991.
4. A. J. Pearson, *Transition Metal-Stabilized Carbocations in Organic Synthesis*, Wiley, 2010.
5. M. Bochmann, *Organometallics and Catalysis: An Introduction*, OUP Oxford; UK Ed., 2014.
6. R. C. Mehrotra, *Organometallic Chemistry: A Unified Approach*, 2nd Ed., New Age International, New Delhi, 2007.
7. B. D. Gupta and A. J. *Elias, Basic Organometallic Chemistry, Concepts, Synthesis and Applications*, 2nd Ed., Basic. Pubs: University Press, 2013.
8. H. Wren, A. C. Cumming, *The Organometallic Compounds of Zinc and Magnesium.* , Leopold Classic Library, 2017.

9. F. C. Whitmore, Organic Chemistry, Volume Two: Part III: *Aromatic Compounds Part IV:Heterocyclic Compounds Part V: Organophosphorus and Organometallic Compounds*, 2nd Ed., Dover Publications, 2011).
10. P. Perez, *Advances in Organometallic Chemistry*, 1st Ed., Academic Press 2018.
11. C. Elschenbroich and A. Salzer, *Organometallic Chemistry*, 2nd Ed., Weinheim, 1992.
12. R. Whyman, Applied Organometallic Chemistry and Catalysis., Oxford University Press, 2004.
13. B. C. Chapman Hall, *Heterogeneous Catalysis*, 2nd Ed., 1987.
14. G. W. Parshall and S. D. Ittel, *Homogenous Catalysis: the Applications and Chemistry of Catalysis by Soluble Transition Metal Complexes*, 2nd Ed., Wiley, 1992.
15. R.M. Roat- Malone, *Bioinorganic Chemistry:A short Course*, JohnWiley& Sons, 2007

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Five-year Integrated M.Sc. Chemistry
Teaching Plan (Feb 2021-May 2021)

Semester: X
Course: Organometallic Chemistry-Elective-III (ICCHM10E003T)
Course Teacher: Dr. Sujata Kundan

Week	Lecture No./Day	Topic to be Taught	No. of Hours	Suggested Readings
1st Week	1,2	**UNIT – I** **Structure and bonding in organometallic:** **Organometallic:** Definition and classification with appropriate examples based on nature of metal-carbon bond (ionic, s, p and multicenter bonds)	2	2, 5, 6
2nd Week	3,4	16 and 18 electron rule and its limitations, Classification of organometallic compounds by bond type, Nomenclature	2	2, 5, 6
3rd Week	5,6	Ziese's salt, EAN rule as applied to carbonyl	2	2, 5, 6
4th Week	7,8	Preparation, structure, bonding and properties of mononuclear and polynuclear carbonyls of 3d-metal ions	2	3, 5, 6
5th Week	9,10	Contd… Synergic effects (VB approach)	2	2, 5, 6
6th Week	11,12	MO diagram of CO can be referred for synergic effect to IR frequencies	2	2, 5, 6
7th Week	13,14	**UNIT – II** **Chemistry of organometallic compounds:** Synthesis and reactions of organomagnesium (Grignard reagent), Organotin, Organomanganese,	2	2, 5, 6,7, 8,9
8th Week	15,16	Synthesis and reactions of Organoaluminium, Organozinc, Organolithium (n-BuLi, PhLi) reagents	2	2, 5, 6,7, 8,9
9th Week	17,18	**Revision and Class test for Unit-I** **Cyclopentadienyl metal complexes:** Metallocenes-Electronic structure and bonding in Ferrocene-Synthesis, Physical and spectroscopic properties of metallocenes	2	2, 3, 6, 7
10th Week	19,20	**Contd…** Transition metal–π complexes with unsaturated organic molecules like alkenes, Alkynes, Allyls, Diene and arene complexes, Preparation, Properties, Chemical reactions, Nature of bonding and structural properties	2	2, 3, 6, 7
11th Week	21,22	Contd…	2	2, 3, 6, 7
12th Week	23,24	Contd…	2	4, 5, 6, 11, 12,1 3
13th Week	25,26	**UNIT – III** **Compounds of transition metal-carbon multiple**	2	4, 5, 6, 11, 12,1 3

		bonds: Alkylidenes, Alkylidynes: Synthesis, Nature of bond, Structural characteristics,		
14th Week	27,28	Nucleophilic and electrophilic reactions of the ligands and applications. N-heterocyclic carbenesLow valent (Fischer) and high valent (Schrock) carbenes and carbines, Carbynes, Isolobal analogy, Metal-metal bond, Transition metal clusters	2	
15th Week	29,30	**Revision and Class test for Units II** **Group Discussion on class test question papers of unit-I**	2	
16th Week	31,32	**Revision and Class Test for Units III** **Group Discussion on class test question papers of unit-II and Unit-III**	2	

References

1. R. H. Crabtree, The Organometallic Chemistry of the Transition Metals, 7th Ed., Wiley, 2019.
2. P. Powell, Principles of Organometallic Chemistry, 2nd Ed., ELBS, 1991.
3. F. A. Cotton, G. Wilkinson, Inorganic Chemistry, 5th Ed., Wiley, 1988.
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Five-year Integrated B.Sc. (Hons.), M.Sc. Chemistry

Teaching Plan (Feb2021-June 2021)

Semester: X
Course: Nano Chemistry (ICCHM10I001T)
Course Teacher: Dr. Shahnawaz. Khan

Week	Lecture No./Day	Topic to be Taught	No of Hours	Suggested Readings
1st Week	I	Introduction to nanomaterials**:** History of nanoscience	1	1-3
	II	Definition of Nanometer, Nanomaterials and Nanotechnology	1	1-3
2nd Week	I	Classification of nanomaterials, Metal clusters	1	1-3
	II	Metal nanoparticles, Semiconductor nanoparticles	1	1-3
3rd Week	I	Polymer nanostructures, Size effects on surface area, Surface energy,	1	1-3
	II	Optical, Electrical, Mechanical and Catalytic properties	1	1-3
4th Week	I	Quantum confinement effect, Quantum dots	1	1-3
	II	Nanowires, Nanorods and Nano film	1	1-3
5th Week	I	Stabilizing agents, Types and its interaction with nanoparticles	1	1-3
	II	Zeta potential. Carbon nanomaterials: Fullerenes synthesis and properties	1	1-3
6th Week	I	Carbon nanotubes (CNT), Types of CNT	1	1-3
	II	Synthesis and growth mechanism	1	1-3
7th week	I	Graphene synthesis and properties	1	1-3
	II	Porous materials, Porous silicon	1	1-3
8th Week	I	Synthesis, mechanism and properties	1	1-3
	II	Mesoporous silica: Synthesis and properties	1	1-3
9th week	I	Mesoporous carbon nanomaterials: Synthesis, properties and applications	1	1-3
	II	Core-shell semiconducting nanoparticles: Different types of core-shell	1	1-3
10th week	I	Synthesis of semiconducting nanoparticles	1	1-3
	II	Surface functionalization of core-shell, Properties	1	1-3
11th	I	Aerogels and hydrogels: Types, fabrication methods	1	1-3

week	II	properties of aerogels and hydrogels	1	1-3
12th week	I	Bioavailability and delivery of nutraceuticals	1	1-3
	II	functional foods using nanotechnology	1	1-3
13th week	I	Nanopolymers synthesis and application	1	1-3
	II	Polymer-based nanocomposites for food packaging	1	3-5
14th week	I	Toxicity and environmental risks of nanomaterials.	1	3-5
	II	Cyclodextrin based nanomaterials	1	3-5
15th week	I	Nanobiosesors and their application	1	3-5
	II	Optical biosensors based on nanoplasmonics	1	3-5
16th week	I	Revision of Units I	1	
	II	Revision of Units III and v	1	

REFERENCES

1. C. N. R. Rao, A. Muller and A. K. Cheetham, Eds., *The Chemistry of Nanomaterials*,Wiley-VCH, Germany, 2004.
2. G. Ozin, A. Arsenaut, Eds., *Nanochemistry: A Chemical Approach to Nanomaterials*, Royal Society of Chemistry, London, 2005.
3. T. Pradeep, *Nano: The Essentials, Understanding Nanoscience and Nanotechnology*, McGraw Hill Education, New Delhi, 2007.
4. M. S. Ramachandra Rao and Shubra Singh, *Nanoscience and Nanotechnology: Fundamentals to Frontiers*, Wiley, 2014.
5. S. K. Kulkarni, *Nanotechnology: Principles and Practices,* Springer, 2011.

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Teaching plan (Feb 2021-June 2021)

Semester: X
Course Name: Nano Chemistry (ICCHM10I001T)
Course Code: Dr. Shilpi Balgotra

Week	Lecture No./ Day	Topic to be Taught	No. of Hours	Suggested Readings
1st Week	I	**Synthesis of nanomaterials**: Physical vapour deposition, Laser ablation	1	1-5
	II	Laser pyrolysis, Sputter deposition: DC, RF	1	1-5
2nd Week	I	Magnetron sputtering Chemical vapour deposition	1	1-5
	II	Chemical Methods: Colloidal in solution, Nucleation and growth of nanoparticles	1	1-5
3rd Week	I	Synthesis of metal and semiconductor nanoparticles via colloidal route,	1	1-5
	II	Sol-gel method, Hydrothermal method Sonochemical method	1	1-5
4th Week	I	Microwave method, Biogenic Methods	1	1-5
	II	Synthesis using microorganism and plants extracts	1	1-5
5th week	I	Synthesis of nanoparticles using proteins, templates like DNA	1	1-5
	II	**Self-assembly of nanomaterials:** Mechanism of self assembly	1	1-5
6th Week	I	Self assembly of nanoparticles using organic molecules	1	1-5
	II	Self assembly in biological systems and Inorganic materials	1	1-5
7th Week	I	**Characterization of nanomaterials:** Diffraction Techniques: X-ray diffraction	1	1-5
	II	Dynamic light scattering, Spectroscopic techniques: Absorption spectroscopy	1	1-5
8th Week	I	Fluorescence spectroscopy	1	1-5
	II	Infrared spectroscopy	1	1-5
9th Week	I	Raman, X-ray photoelectron spectroscopy	1	1-5
	II	Ultraviolet photoelectron spectroscopy	1	1-5
10th Week	I	Microscopic techniques: Scanning probe,	1	1-5
	II	Scanning electron microscope, Transmission electron microscope	1	1-5
11th Week	I	**Applications of nanomaterials:** Dye sensitized solar cell	1	1-5
	II	Polymer solar cell and fuel cell	1	1-5

12th Week	I	Optical (colorimetric and fluorescence) sensor	1	1-5
	II	Electrochemical sensor, Water purification	1	1-5
13th	I	**Nanotechnology in food, medicine and health sciences**: Nano particle based drug delivery systems	1	1-4
Week	II	Ultra sound triggered Nano/Microbubbles	1	1-4
14th Week	I	Regenerative medicine	1	1-4
	II	Nanoimmuno conjugates	1	1-4
15th Week	I	Biosensors, Optical biosensors based on nanoplasmonics	1	1-4
	II	Nanobiosesors	1	1-4
16th Week	I	Revision of unit II	1	
	II	Revision of unit IV	1	

REFERENCES

1. C. N. R. Rao, A. Muller and A. K. Cheetham, Eds., *The Chemistry of Nanomaterials*, Wiley-VCH, Germany, 2004.
2. G. Ozin, A. Arsenaut, Eds., Nanochemistry: *A Chemical Approach to Nanomaterials*, Royal Society of Chemistry, London, 2005.
3. T. Pradeep, Nano*: The Essentials, Understanding Nanoscience and Nanotechnology*, McGraw Hill Education, New Delhi, 2007.
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