Indian Institute of Science Education and Research Berhampur

Proposal of a New Course

Department of Chemical Sciences

Course Title	**General Chemistry I**				
Course Level (tick (√) in the relevant option)	100 ✓☐ 200 ☐ 300 ☐ 400 ☐ 500 ☐ 600 ☐ 700 ☐			Semester: Odd ✓☐ Even ☐ Either semester ☐	
Course applicable for	BSMS ✓☐ Int. PhD. ☐ Ph.D. ☐				
Tag of the course (tick (√) in the relevant option(s))	Institute Core ✓☐ Professional (Department) Core ☐ Department Elective ☐ Open Elective ☐ Minor ☐				
Type of the course	Theory ✓☐ Lab ☐ Project ☐ Non-Credit ☐				
Credit Structure	Lectures (L)	Tutorials (T)	Practicals (P)	Total Credits	
	3	0	0	3	
Course Code:	**CH101**				
Names of faculties who can teach the course	**All of the existing faculty members of the Department of Chemical Sciences can teach this course.**				
Will the course require participation of visiting faculties: ~~Yes~~ / No					
Prerequisites, if any Course code(s)	Nil				

Learning Objective(s):

This is an introductory course that covers fundamental concepts in chemistry. The course will focus on a conceptual understanding of the principles of general chemistry.

Expected Learning Outcome(s):

After completing this course, the students will be well-versed in the fundamental concepts of atomic structure, periodicity of elemental properties, chemical bonding and reactivity, electronic effects of the molecules. This course will help strengthen basic concepts like electronic effects, reactive intermediates, acids/bases, and stereochemistry.

Contents of the course:

Polyelectronic Atomic Configuration, Periodic table and the concept of periodicity, Chemical bonding, Molecular orbital theory, Structure of solids, Electronic effects and reactive intermediates, Concept of aromaticity, Concept of acids and bases, Basic stereochemistry.

Lecture Outline: (Not more than 6 lectures per module)

Module No.	Topic	No. of Hours
1.	**Polyelectronic Atomic Configuration**: Atomic structure as the basis for periodicity and concept of orbitals. Electronic configuration of polyelectronic atoms.	5
2.	**Periodic table and the concept of periodicity:** Applications of the periodic law. Effective nuclear charge; Slater's rules, screening effect. Size of atoms and ions, ionization energies; electronegativity, electron affinity; periodic properties of elements and periodic trends, diagonal relationships, inert-pair effect; Fajan's rules.	5
3.	**Chemical bonding**: Lewis theory; Formal charges, resonance and rationalization of structures; VSEPR theory and shapes of molecules. Applications of VSEPR theory in predicting trends in bond lengths and bond angles.	4

4.	**Molecular orbital theory**: Orbital mixing: sigma, pi bonding orbital diagrams of homo and hetero-diatomic molecules, concept of HOMO, LUMO and SOMO.	4
5.	**Structure of solids**: Crystal packing, lattice energy and Born-Haber cycle.	2
6.	**Electronic effects and reactive intermediates:** Dipole moment, inductive and field effects, polarizability, resonance effect, mesomeric effects, tautomerism, hyper-conjugation; arrow pushing concepts in organic chemistry, Carbocation, Carbanion, etc.	5
7.	**Concept of aromaticity**: Fundamental aspects of aromaticity, anti-aromaticity, and non-aromaticity.	2
8.	**Concept of acids and bases:** Various theories of Acids and bases; Brønsted acids and bases. Protonic acids, gas-phase vs solution behavior of acids. Lewis acidity, 'Hard' and 'Soft' Acids and Bases. Solid acids. Acidity, basicity, and pKa: Acidity, Basicity, definition of pKa, factors that influence the acidity and basicity, levelling effect, predicting acid strengths, HSAB Principle.	4
9.	**Basic stereochemistry:** Fischer, Newman, saw-horse, etc., projection formulae Conformational analysis of ethane, propane, butane, cyclohexane and monosaccharides. Stereoisomerism, configuration (R, S), optical isomerism in compounds with one and two chiral centers, and without an asymmetric atom, nomenclatures such as erythro, threo, α, β, endo, exo epimers, anomers, E, Z, etc., resolution of racemic compounds.	6
10.	**General discussions and doubt clearing**	5
	Total no. of hours	**42**

Brief Description of Tutorial Activities: NA

Module No	Topic	No. of Hours

Brief Description of Laboratory Activities: NA

Experiment No:	Topic	No. of Hours

Suggested Reading: (Please use the format: Author(s) (Surname first), Title, Publisher, Year of publication.

1) Housecroft, C. E., & Sharpe, A. G. (2018). Inorganic Chemistry (5th ed.). Pearson Education.
2) Atkins, P. W., Overton, T. L., Rourke, J. P., Weller, M. T., & Armstrong, F. A. (2010). Shriver & Atkins' inorganic chemistry (5th ed.). Oxford University Press.
3) House, J.E. Inorganic Chemistry, 3rd ed. Academic Press, 2020.
4) Kotz, J. C., Treichel, P. M., Townsend, J. R., Chemistry and Chemical Reactivity, 7th Edition, Brooks/Cole, Cengage Learning, Canada, 2010.
5) Chang, R., Chemistry, 9th edition, McGraw-Hill, 2006.
6) Clayden, J., Greeves, N., Warren, S., Wothers, S. Organic Chemistry, Oxford University Press, 2001.
7) Hornback, J. M. Organic Chemistry, Cengage Learning, 2006.
8) Sykes, P. A., A guidebook to mechanism in organic chemistry, Longman, 2008.
9) Nasipuri, D., Stereochemistry of Organic Compounds, 4th ED 2020.

Modalities for Students Performance Assessment (with details of weightage for different components of performance assessment within the broad guidelines given in BS-MS/PhD manual):

Continuous assessment (class test, assignments, quiz, etc.), mid-Semester and end-Semester examinations (the weightage of these components will be as per the Institute BS-MS manual).
Additional Guidelines: There must be at least 6 hours of discussion and doubt clearing sessions throughout the course. If required, tutorials should be taken separately, outside the lecture hours.

Name and Signature of course proposer(s): **The Departmental UG Committee, DCS.**

Similarity with the existing courses, if any: Nil

(Similarity content is declared as per the number of lecture hours on similar topics)

S. No.	Name of the Course	Course Code	Similarity Content	Approx. % of Content
1.				
2				

Justification of new course proposal if cumulative similarity content is >30%: NA

Recommendation of External experts/Senate members/Subject expert(s)

Description (Add separate sheet, if required)	Description (Add separate sheet, if required)

The above proposal followed by the recommendations of the External experts/Senate members/Subject expert(s) appointed by Director is found to be acceptable by the DUGC/DPGC in its meeting held on_____. The committee recommended the introduction of new course for consideration of CoAA/DoAA and Director/Chairperson Senate.

Convener, DUGC Convener, DPGC	FIC/HoD

For Use of the Academic Section

Recommended/Not Recommended to Senate Chairperson	Coordinator/Dean, Academic Affairs
Recommended / Not Recommended for the approval/ratification by the Senate Director/Chairperson Senate	

Indian Institute of Science Education and Research Berhampur

Proposal of a New Course

Department of Chemical Sciences

Course Title	**General Chemistry II**				
Course Level (tick (√) in the relevant option)	100 ✓☐ 200 ☐ 300 ☐ 400 ☐ 500 ☐ 600 ☐ 700 ☐			Semester: Odd ☐ Even ✓☐ Either semester ☐	
Course applicable for	BSMS ✓☐ Int. PhD. ☐ Ph.D. ☐				
Tag of the course (tick (√) in the relevant option(s))	Institute Core ✓☐ Professional (Department) Core ☐ Department Elective ☐ Open Elective ☐ Minor ☐				
Type of the course	Theory ✓☐ Lab ☐ Project ☐ Non-Credit ☐				
Credit Structure	Lectures (L)	Tutorials (T)	Practicals (P)	Total Credits	
	3	0	0	3	
Course Code:	**CH102**				
Names of faculties who can teach the course	**All of the existing faculty members of the Department of Chemical Sciences can teach this course.**				
Will the course require participation of visiting faculties: ~~Yes~~ / No					
Prerequisites, if any Course code(s)	Nil				

Learning Objective(s):

This course guides students in acquiring a comprehensive understanding of the chemistry that they experience in their daily lives, covering the fundamentals of chemistry. Students will develop fundamental understanding of key concepts such basic reaction mechanisms, common organic reactions and rearrangements, chemical bonding, molecular structure, redox reactions, and basic aspects of nuclear chemistry. It will also impart the basic knowledge of physical chemistry such as kinetic theory of gases, transformation of energy into different forms and its relation to physical observables and provide fundamental physical concepts.

Expected Learning Outcome(s):

Upon completion of this course, the students will comprehend and recognize the core principles of three major disciplines in Chemistry, *viz*, Organic, Inorganic, and Physical Chemistry. It will build the foundation to understand the advanced courses in chemistry in the upcoming semesters.

Contents of the course

Basic reaction mechanisms in organic chemistry, common organic reactions. Rearrangements in organic chemistry. Bonding in non-transition metal chemistry, radioactivity and nuclear chemistry. Oxidation and Reduction. Kinetic theory of gases, basic thermodynamics, basic chemical kinetics.

Lecture Outline: (Not more than 6 lectures per module)

Module No.	Topic	No. of Hours
1.	**Basic reaction mechanisms in organic chemistry:** Electrophilic and radical additions to alkenes, electrophilic and nucleophilic aromatic substitutions.	3
2.	**Common organic reactions:** Nucleophilic aliphatic substitutions: SN1, SN2, SNi reactions, neighboring group participation, elimination reactions: E1, E2, and E1cB reactions, aromatic nucleophilic substitution. Functional group transformations and their reaction mechanisms.	4
3.	**Rearrangements in organic chemistry:** Electrophilic (Beckmann, Hofmann, Lossen, Curtius, Wolff, Schmidt, Baeyer-Villiger,	5

	Pinacol-pinacolone, Wagner-Meerwein etc.), nucleophilic (benzilic acid, Favorskii), and radical rearrangements (Wittig, aza-Wittig). Sigmatropic rearrangements (Cope, aza-Cope, Oxy-Cope, Claisen, aza-Claisen, Eschenmoser-Claisen, vinyl cyclopropane-cyclopentene).	
4.	**Bonding in non-transition metal chemistry**: An overview of bonding models in inorganic chemistry, Chemical forces, Bent's rule, Application of molecular orbital theory to polyatomic molecules (localized and delocalized orbitals), Walsh diagrams, introduction to group theory/symmetry operations.	5
5.	**Radioactivity and Nuclear Chemistry:** The nature of radioactive radiations, detection and measurements. Theory of disintegration, disintegration series. Half-life and average life period, artificial radioactivity, applications. Nuclear fission, nuclear fusion, critical mass.	3
6.	**Oxidation and Reduction:** The central role of transfer of electrons in chemical processes. The importance of water splitting. Redox chemistry of extraction (Ellingham diagrams). Conversion of chemical energy into electricity. Batteries and modern state of solid state batteries, Fuel cells.	4
7.	**Kinetic theory of gases:** Gas Laws, equation of states, critical constants, law of corresponding states, Distribution of molecular speeds and its applications, mean-free path, compressibility factor, barometric distribution law, Heat capacity of gases, real gases and virial expansions.	5
8.	**Basic Thermodynamics**: Basic concept and definition of systems, surroundings, boundaries, reversible and irreversible processes, concept of heat, work, and internal energy, state and path functions, exact and inexact differentials, introduction to zero-th, first and second laws of Thermodynamics.	4
9.	**Basic Chemical Kinetics:** Order and molecularity of a reaction, Integrated rate laws for zero-th, 1st, 2nd and nth order reactions, half-life of various reactions, pseudo orders and molecularities, reversible, consecutive and parallel first order reactions.	3
10.	**General discussions and doubt-clearing**	6
	Total Number of Lecture Hours	**42**

Brief Description of Tutorial Activities: NA

Module No	Topic	No. of Hours

Brief Description of Laboratory Activities: NA

Experiment No:	Topic	No. of Hours

Suggested Reading: (Please use the format: Author(s) (Surname first), Title, Publisher, Year of publication.

1) Clayden, J., Greeves, N., Warren, S., Wothers, S. Organic Chemistry, Oxford University Press, 2001.
2) Sykes, P. A., A guidebook to mechanism in organic chemistry, Longman, 2008.
3) March's advanced organic chemistry, Michael B. Smith, Jerry March
4) Shriver and Atkins, Inorganic Chemistry, Fourth Edition, Oxford University Press, 2006.
5) Lee, J. D., Concise Inorganic Chemistry, Fifth Edition, Blackwell Publishing, 2006.

6) Huheey, J. E., Keiter, E. A., Keiter, R. L., Inorganic Chemistry-Principles of Structure and Reactivity. 4th Edn. Harper-Collins, NY, 1993.
7) Atkins, P. W., Paula, J. de, Keeler, J., Atkins' Physical Chemistry, Ed. 11th, Oxford University Press, 2018.
8) Levine, I., Physical Chemistry, Ed. 6th, McGraw Hill, 2009.
9) Castellan, G. W., Physical Chemistry, Ed. 3rd, Narosa Publishing House, 2004.

Modalities for Students Performance Assessment (with details of weightage for different components of performance assessment within the broad guidelines given in BS-MS/PhD manual):

Continuous assessment (class test, assignments, quiz, etc.), mid-Semester and end-Semester examinations (the weightage of these components will be as per the Institute BS-MS manual).

Additional Guidelines:

There must be at least 6 hours of discussion and doubt clearing sessions throughout the course. If required, tutorials should be taken separately, outside the lecture hours.

Name and Signature of course proposer(s):

The Departmental UG Committee, DCS.

Similarity with the existing courses, if any: Nil

(Similarity content is declared as per the number of lecture hours on similar topics)

S. No.	Name of the Course	Course Code	Similarity Content	Approx. % of Content
1.				
2				

Justification of new course proposal if cumulative similarity content is >30%: NA

Recommendation of External experts/Senate members/Subject expert(s)

Description (Add separate sheet, if required)	Description (Add separate sheet, if required)

The above proposal followed by the recommendations of the External experts/Senate members/Subject expert(s) appointed by Director is found to be acceptable by the DUGC/DPGC in its meeting held on_____. The committee recommended the introduction of new course for consideration of CoAA/DoAA and Director/Chairperson Senate.

Convener, DUGC Convener, DPGC	FIC/HoD

For Use of the Academic Section

Recommended/Not Recommended to Senate Chairperson	Coordinator/Dean, Academic Affairs
Recommended / Not Recommended for the approval/ratification by the Senate Director/Chairperson Senate	

Indian Institute of Science Education and Research Berhampur

Proposal of a New Course

Department of Chemical Sciences

<table>
<tr><td>Course Title</td><td colspan="5">General Chemistry Laboratory</td></tr>
<tr><td>Course Level (tick (√) in the relevant option)</td><td colspan="3">100 ✓☐ 200 ☐ 300 ☐ 400 ☐ 500 ☐ 600 ☐ 700 ☐</td><td colspan="2">Semester: Odd ☐ Even ✓☐
Either semester ☐</td></tr>
<tr><td>Course applicable for</td><td colspan="3">BSMS ✓☐ Int. PhD. ☐ Ph.D. ☐</td><td colspan="2"></td></tr>
<tr><td>Tag of the course (tick (√) in the relevant option(s))</td><td colspan="5">Institute Core ✓☐ Professional (Department) Core ☐ Department Elective ☐ Open Elective ☐
Minor ☐</td></tr>
<tr><td>Type of the course</td><td colspan="5">Theory ☐ Lab ✓☐ Project ☐ Non-Credit ☐</td></tr>
<tr><td rowspan="2">Credit Structure</td><td>Lectures (L)</td><td>Tutorials (T)</td><td>Practicals (P)</td><td>Total Credits</td><td></td></tr>
<tr><td>0</td><td>0</td><td>3</td><td>1</td><td></td></tr>
<tr><td>Course Code:</td><td colspan="5">CH104</td></tr>
<tr><td>Names of faculties who can teach the course</td><td colspan="5">All of the existing faculty members of the Department of Chemical Sciences can teach this course.</td></tr>
<tr><td colspan="6">Will the course require participation of visiting faculties: ~~Yes~~ / No</td></tr>
<tr><td>Prerequisites, if any Course code(s)</td><td colspan="5">Nil</td></tr>
</table>

Learning Objective(s):
This is an introductory course that imparts hands-on knowledge on the Laboratory experiments covering fundamental concepts in three major disciplines in Chemistry, viz, Inorganic, Organic and Physical Chemistry.

Expected Learning Outcome(s):
After completing this course, the students will learn experimental execution of basic chemical reactions and develop fundamental understanding on the synthesis, purification, analysis, and kinetics involved in the same. This course will improve their skill on analyzing and interpreting experimental data.

Contents of the course:

1. Familiarization of common lab apparatus (weighing balance, burette, pipette, volumetric flask, conductometer, water bath, hot plates etc.).
2. Extraction of (i) solids in a solvent, and (ii) two miscible liquids. Purification of compounds via crystallization and sublimation.
3. Determination of the strength of acid and base/ Estimation of alkali content in commercial antacid tablets.
4. Determination of purity by melting points and TLC.
5. Crystallization of benzoic acid.
6. Estimation of % amount of calcium and magnesium in a milk sample.
7. Estimation of Iodine in Iodized common salt.
8. Chemistry of invisible ink.
9. Chemical detectives in forensic analysis.
10. Separation of naphthol, aspirin, and naphthalene.
11. Synthesis of polymer, Nylon 6-10.
12. Estimation of acetic acid in vinegar solution.
13. Preparation of pyridinium chlorochromate (PCC).
14. Determination of acid dissociation constant (pKa) of: (A) polybasic acid (H_3PO_4), (B) Monobasic Acid (CH_3COOH).
15. Kinetics of saponification of ethyl acetate using conductometry.
16. Preparation of $Cu(NH_3)_4SO_4$ and estimation of copper(II) using standard thiosulfate solution as titrant.

Lecture Outline: (Not more than 6 lectures per module) **NA**

Module No	Topic	No. of Hours

Brief Description of Tutorial Activities: NA

Module No	Topic	No. of Hours

Brief Description of Laboratory Activities:

Experiment No:	Topic	No. of Hours
1.	Familiarization of common lab apparatus (weighing balance, burette, pipette, volumetric flask, conductometer, water bath, hot plates etc.).	3
2.	Extraction of (i) solids in a solvent, and (ii) two miscible liquids. Purification of compounds via crystallization and sublimation.	3
3.	Determination of the strength of acid and base/ Estimation of alkali content in commercial antacid tablets.	3
4.	Determination of purity by melting points and TLC.	3
5.	Crystallization of benzoic acid.	3
6.	Estimation of % amount of calcium and magnesium in a milk sample.	3
7.	Estimation of Iodine in Iodized common salt.	3
8.	Chemistry of invisible ink.	3
9.	Chemical detectives in forensic analysis.	3
10.	Separation of naphthol, aspirin, and naphthalene.	3
11.	Synthesis of polymer, Nylon 6-10.	3
12.	Estimation of acetic acid in vinegar solution.	3
13.	Preparation of pyridinium chlorochromate (PCC).	3
14.	Determination of acid dissociation constant (pKa) of: (A) polybasic acid (H_3PO_4), (B) Monobasic Acid (CH_3COOH).	3
15.	Kinetics of saponification of ethyl acetate using conductometry.	3
16.	Preparation of $Cu(NH_3)_4SO_4$ and estimation of copper(II) using standard thiosulfate solution as titrant.	3
	Total number of hours	**42**

Suggested Reading: (Please use the format: Author(s) (Surname first), Title, Publisher, Year of publication.

Lab Manual, DCS, IISER Berhampur.

Modalities for Students Performance Assessment (with details of weightage for different components of performance assessment within the broad guidelines given in BS-MS/PhD manual):

Continuous laboratory assessment, laboratory record writing and laboratory examinations including viva-voce (the weightage of these components will be as per the Institute BS-MS manual).

Additional Guidelines:

Suggested to perform 12 Experiments out of a library of 16 experiments mentioned in the course content. Time to teach the theory parts associated with the experiments and discussions regarding the same are included in the total hours.

Name and Signature of course proposer(s):

The Departmental UG Committee, DCS.

Similarity with the existing courses, if any: Nil

(Similarity content is declared as per the number of lecture hours on similar topics)

S. No.	Name of the Course	Course Code	Similarity Content	Approx. % of Content
1.				
2				

Justification of new course proposal if cumulative similarity content is >30%: NA

Recommendation of External experts/Senate members/Subject expert(s)

Description (Add separate sheet, if required)	Description (Add separate sheet, if required)

The above proposal followed by the recommendations of the External experts/Senate members/Subject expert(s) appointed by Director is found to be acceptable by the DUGC/DPGC in its meeting held on_____. The committee recommended the introduction of new course for consideration of CoAA/DoAA and Director/Chairperson Senate.

Convener, DUGC Convener, DPGC	FIC/HoD

For Use of the Academic Section

Recommended/Not Recommended to Senate Chairperson	Coordinator/Dean, Academic Affairs
Recommended / Not Recommended for the approval/ratification by the Senate Director/Chairperson Senate	

Indian Institute of Science Education and Research Berhampur

Proposal of a New Course

Department of Chemical Sciences

Course Title	**Organic Chemistry I**				
Course Level (tick (√) in the relevant option)	100 ☐ 200 ✓☐ 300 ☐ 400 ☐ 500 ☐ 600 ☐ 700 ☐			Semester: Odd ✓☐ Even ☐ Either semester ☐	
Course applicable for	BSMS ✓☐ Int. PhD. ☐ Ph.D. ☐				
Tag of the course (tick (√) in the relevant option(s))	Institute Core ✓☐ Professional (Department) Core ☐ Department Elective ☐ Open Elective ☐ Minor ☐				
Type of the course	Theory ✓☐ Lab ☐ Project ☐ Non-Credit ☐				
Credit Structure	Lectures (L)	Tutorials (T)	Practicals (P)	Total Credits	
	3	0	0	3	
Course Code:	**CH201**				
Names of faculties who can teach the course	**All of the existing faculty members of the Department of Chemical Sciences with Organic Chemistry background can teach this course.**				
Will the course require participation of visiting faculties: ~~Yes~~ / No					
Prerequisites, if any Course code(s)	Nil				

Learning Objective(s):

This is an introductory course that covers fundamental concepts in organic chemistry.

Expected Learning Outcome(s):

After completing this course, students will have a thorough understanding of the stereochemistry of organic molecules and basic organic transformations by using several organic reagents. A brief introduction about natural products will provide an opportunity to learn about their importance in daily life.

Contents of the course:

Stereochemistry: conformational analysis, strain in cyclic and acyclic molecules, dynamic stereochemistry. Oxidation of alcohols, ketones and aldehydes, oxidation of C-C double bonds. Reduction of carbonyl compounds, carbon-carbon multiple bonds and other selected functional groups. Selected reagents in organic synthesis, selected functional group transformations in organic synthesis, basic concept of cross-coupling reactions. Introduction to Natural Products.

Lecture Outline: (Not more than 6 lectures per module)

Module No	Topic	No. of Hours
	Stereochemistry	
1.	Conformational analysis, conformation of acyclic, cyclic, fused and bridged systems.	4
2.	Strain in cyclic and acyclic molecules including allylic strain (A1,2 and A1,3).	2
3.	Dynamic stereochemistry: Conformation and reactivity, Curtin-Hammett principle, and its applications and case studies.	3
	Oxidation of alcohols, ketones and aldehydes	
4.	Oxidation of alcohols: Chromium reagents, oxidation via alkoxysulfonium salts, Manganese reagents, other metal-based oxidants, other non-metal-based oxidants.	3

5.	Oxidation of ketones and aldehydes: Oxidation to carboxylic acids or esters, oxidation of alpha, beta-Unsaturated ketones and alpha -Hydroxy-ketones, Baeyer–Villiger oxidation of ketones.	3
6.	**Oxidation of C-C double bonds:** Ozonolysis, dihydroxylation (OsO_4, $NaIO_4$, $KMnO_4$, $Pb(OAc)_4$, Woodward–Pre´vost reaction and etc.), epoxidation (m-CPBA, peroxides, dimethyl dioxirane), aziridination, amino-hydroxylation etc.	3
	Reductions	
7.	Reduction of carbonyl compounds	3
8.	Reduction of carbon-carbon multiple bond (catalytic hydrogenation, diimide reduction)	3
9.	Reduction of other functional groups, dissolving metal reductions etc.	3
	Selected reagents in organic synthesis	
10.	Barbier and Grignard, organolithium, organosilicon, organo zinc-based organometallic reactions involving C-C bond formations	3
11.	Selected functional group transformations in organic synthesis, basic concept of cross-coupling reactions.	3
12.	**Introduction to Natural Products:** Historical overview of natural products in daily life: Medicinal Plants in Folklore, Medicinal Natural Products from Other Sources Used in Folklore, Primary and Secondary Metabolites (Natural Products), A few case studies.	3
13.	**General discussions and doubt clearing**	6
	Total number of hours	**42**

Brief Description of Tutorial Activities: NA

Module No	Topic	No. of Hours

Brief Description of Laboratory Activities: NA

Experiment No:	Topic	No. of Hours

Suggested Reading: (Please use the format: Author(s) (Surname first), Title, Publisher, Year of publication.

1. Clayden, J., Greeves, N., Warren, S., Wothers, S. Organic Chemistry, Oxford University Press, 2001.
2. Hornback, J. M. Organic Chemistry, Cengage Learning, 2006.
3. Eliel, E. L., Wilen, S. H., Doyle, M. P. Basic Organic Stereochemistry, John Wiley and Sons, 2001.
4. CARRUTHERS, W., COLDHAM, I., MODERN METHODS OF ORGANIC SYNTHESIS, Cambridge University Press
5. Smith, M. B. and March, J. Advanced Organic Chemistry, Wiley Interscience, 2007.
6. Carey, F. A, Sundberg, R. J. Advanced Organic Chemistry, Part A and B, Springer, 2007.
7. Encyclopedia of Reagents for Organic Synthesis, Editor: L. Paquette, D. Crich, P. Fuchs, G. Molander.
8. Natural Products: Isolation, Structure Elucidation, History; Author(s):Prof. Dr. Dieter Sicker, Prof. Dr. Klaus-Peter Zeller, Prof. Dr. Hans-Ullrich Siehl, Prof. Dr. Stefan Berger; First published: 30 January 2019; Print ISBN:9783527341948 |Online ISBN:9783527806508 |DOI:10.1002/9783527806508; © 2019 WILEY-VCH Verlag GmbH & Co.
9. Molecules That Changed the World: A Brief History of the Art and Science of Synthesis and Its Impact on Society by K. C. Nicolaou and T. Montagnon.

Modalities for Students Performance Assessment (with details of weightage for different components of performance assessment within the broad guidelines given in BS-MS/PhD manual):

Continuous assessment (class test, assignments, quiz, etc.), mid-Semester and end-Semester examinations (the weightage of these components will be as per the Institute BS-MS manual).
Additional Guidelines: There must be 5 hours of discussion and doubt clearing sessions throughout the course. If required, tutorials should be taken separately, outside the lecture hours.

Name and Signature of course proposer(s): **The Departmental UG Committee, DCS**

Similarity with the existing courses, if any: Nil

(Similarity content is declared as per the number of lecture hours on similar topics)

S. No.	Name of the Course	Course Code	Similarity Content	Approx. % of Content
1.				
2.				

Justification of new course proposal if cumulative similarity content is >30%: NA

Recommendation of External experts/Senate members/Subject expert(s)

Description (Add separate sheet, if required)	Description (Add separate sheet, if required)

The above proposal followed by the recommendations of the External experts/Senate members/Subject expert(s) appointed by Director is found to be acceptable by the DUGC/DPGC in its meeting held on_____. The committee recommended the introduction of new course for consideration of CoAA/DoAA and Director/Chairperson Senate.

Convener, DUGC Convener, DPGC	FIC/HoD

For Use of the Academic Section

Recommended/Not Recommended to Senate Chairperson	Coordinator/Dean, Academic Affairs
Recommended / Not Recommended for the approval/ratification by the Senate Director/Chairperson Senate	

Indian Institute of Science Education and Research Berhampur

Proposal of a New Course

Department of Chemical Sciences

Course Title	**Introduction to Spectroscopic Methods in Chemistry**					
Course Level (tick (√) in the relevant option)	100 ☐ 200 ✓☐ 300 ☐ 400 ☐ 500 ☐ 600 ☐ 700 ☐			Semester: Odd ☐ Even ✓☐ Either semester ☐		
Course applicable for	BSMS ✓☐ Int. PhD. ☐ Ph.D. ☐					
Tag of the course (tick (√) in the relevant option(s))	Institute Core ✓☐ Professional (Department) Core ☐ Department Elective ☐ Open Elective ☐ Minor ☐					
Type of the course	Theory ✓☐ Lab ☐ Project ☐ Non-Credit ☐					
Credit Structure	Lectures (L)	Tutorials (T)	Practicals (P)	Total Credits		
	3	0	0	3		
Course Code:	**CH202**					
Names of faculties who can teach the course	**All the existing faculty members of the Department of Chemical Sciences can teach this course.**					
Will the course require participation of visiting faculties: ~~Yes~~/ No						
Prerequisites, if any Course code(s)	Nil					

Learning Objective(s):

The course will introduce students to the basic concepts of spectroscopy, their associated instrumental techniques and working principle.

Expected Learning Outcome(s):

After completing this course, students will be able to analyze the data generated during the laboratory courses so as to develop the basic structural understanding of chemical compounds.

Contents of the course:

Introduction to spectroscopy, Microwave spectroscopy, Infrared spectroscopy, Raman spectroscopy, Electronic spectroscopy, Magnetic resonance spectroscopy, Mass spectroscopy.

Lecture Outline: (Not more than 6 lectures per module)

Module No.	Topic	No. of Hours
1.	**Introduction to spectroscopy**: Electromagnetic spectrum, representation of spectra, resolution and sensitivity.	3
2.	**Microwave spectroscopy**: Basic principles of microwave spectroscopy with the classical concept of rigid rotor and its instrument details.	5
3.	**Infrared spectroscopy**: Basic principles of infrared spectroscopy from the classical concept of simple harmonic oscillator and its basic instrumental details.	6
4.	**Raman spectroscopy**: Introduction to Raman spectroscopy to stokes, antistokes and rayleigh scattering. Differences between Raman and IR spectroscopy.	5
5.	**Electronic spectroscopy**: Basics of UV-Visible absorption spectroscopy, fluorescence and phosphorescence spectroscopy. General details of the instruments.	6

6.	**Magnetic resonance spectroscopy**: Fundamental concepts of NMR & EPR spectroscopy, the concept of spin.	5
7.	**Mass spectroscopy**: Introduction to mass spectrometry and its use in identification of chemical compounds.	4
8.	**General discussion and doubt clearing**	8
	Total number of hours	**42**

Brief Description of Tutorial Activities: NA

Module No	Topic	No. of Hours

Brief Description of Laboratory Activities: NA

Experiment No:	Topic	No. of Hours

Suggested Reading: (Please use the format: Author(s) (Surname first), Title, Publisher, Year of publication.

1. C. N. Banwell, E. M. McCash, Fundamentals of Molecular Spectroscopy, 4th Ed, Tata McGraw-Hill, New Delhi (1995).
2. D. L. Pavia, G. M. Lampman, G. S. Kriz, Introduction to Spectroscopy, 3rd Ed, Cengage, India Edition (2001).
3. W. Kemp, Organic Spectroscopy, 3rd Ed, Palgrave, New York (1991).
4. I. N. Levine, Physical Chemistry, 5th Ed, Tata McGraw-Hill, New Delhi (2007).
5. Introduction to Solid State Chemistry by A R West.

Modalities for Students Performance Assessment (with details of weightage for different components of performance assessment within the broad guidelines given in BS-MS/PhD manual):

Continuous assessment (class test, assignments, quiz, etc.), mid-Semester and end-Semester examinations (the weightage of these components will be as per the Institute BS-MS manual).

Additional Guidelines:

There must be at least 7-8 hours of discussion and doubt clearing sessions throughout the course (as mentioned in the lecture outline). If required, tutorials should be taken separately, outside the lecture hours.

Name and Signature of course proposer(s):

The Departmental UG Committee, DCS

Similarity with the existing courses, if any: Nil

(Similarity content is declared as per the number of lecture hours on similar topics)

S. No.	Name of the Course	Course Code	Similarity Content	Approx. % of Content

1.				
2				

Justification of new course proposal if cumulative similarity content is >30%: NA

Recommendation of External experts/Senate members/Subject expert(s)

Description (Add separate sheet, if required)	Description (Add separate sheet, if required)

The above proposal followed by the recommendations of the External experts/Senate members/Subject expert(s) appointed by Director is found to be acceptable by the DUGC/DPGC in its meeting held on_____. The committee recommended the introduction of new course for consideration of CoAA/DoAA and Director/Chairperson Senate.

Convener, DUGC Convener, DPGC	FIC/HoD

For Use of the Academic Section

Recommended/Not Recommended to Senate Chairperson	Coordinator/Dean, Academic Affairs
Recommended / Not Recommended for the approval/ratification by the Senate Director/Chairperson Senate	

Indian Institute of Science Education and Research Berhampur

Proposal of a New Course

Department of Chemical Sciences

Course Title	**Synthetic Chemistry Laboratory**				
Course Level (tick (√) in the relevant option)	100 ☐ 200 ✓☐ 300 ☐ 400 ☐ 500 ☐ 600 ☐ 700 ☐			Semester: Odd ✓☐ Even ☐ Either semester ☐	
Course applicable for	BSMS ✓☐ Int. PhD. ☐ Ph.D. ☐				
Tag of the course (tick (√) in the relevant option(s))	Institute Core ✓☐ Professional (Department) Core ☐ Department Elective ☐ Open Elective ☐ Minor ☐				
Type of the course	Theory ☐ Lab ✓☐ Project ☐ Non-Credit ☐				
Credit Structure	Lectures (L)	Tutorials (T)	Practicals (P)	Total Credits	
	0	0	3	1	
Course Code:	**CH203**				
Names of faculties who can teach the course	**All of the existing faculty members of the Department of Chemical Sciences with Inorganic/ Organic Chemistry background can teach this course.**				
Will the course require participation of visiting faculties: ~~Yes~~ / No					
Prerequisites, if any Course code(s)	Nil				

Learning Objective(s):

This is an introductory course that imparts hands-on knowledge on Laboratory experiments covering fundamental concepts in organic and inorganic chemistry, and correlates theoretical knowledge with experiments.

Expected Learning Outcome(s):

After completing this course, the students will learn practical experimental execution of basic chemical reactions including synthesis, purification of simple and common inorganic and organic compounds, their analysis, and gather knowledge on the interpretation of experimental data.

Contents of the course:

Inorganic Chemistry Experiments:

1. Preparation of [Ni(NH3)6]2+ & Ni estimation (Complexometrical & Gravimetrical).
2. Preparation of Ni or Co-Acetylacetonate.
3. Preparation of a Metal Complex with a Multidentate Ligand: Preparation of Polynuclear Thiourea Complex of Copper (I).
4. Recycling of Aluminum: Preparation of Potash Alum from waste Aluminum.
5. Estimation of Barium ion in Barium sulfate.
6. Blueprinting: Study of Photochemical Reduction of a Ferric salt.
7. Determination of spectrochemical order of ligands by using electronic spectroscopy of Nickel(II) coordination complexes.

Organic Chemistry Experiments:

1. Electrophilic aromatic substitution: Nitration of acetanilide.
2. Beckmann rearrangement: Preparation of benzanilide from benzophenone oxime.
3. Aldol reaction: Preparation of dibenzylideneacetone.
4. Baylis-Hillman reaction of ethyl acrylate and benzaldehyde.
5. Reduction of ketone: Preparation of benzhydrol by NaBH4 reduction of benzophenone
6. Preparation of amide: Synthesis of acetanilide from aniline
7. The Suzuki-Miyaura reaction: Synthesis of 4-nitro-1,1'-biphenyl compound.

Lecture Outline: (Not more than 6 lectures per module) **NA**

Module No	Topic	No. of Hours

Brief Description of Tutorial Activities: NA

Module No	Topic	No. of Hours

Brief Description of Laboratory Activities:

Experiment No:	Topic	No. of Hours
1.	Nitration of acetanilide	3
2.	Preparation of benzanilide from benzophenone oxime	3
3.	Preparation of dibenzylideneacetone	3
4.	Baylis-Hillman reaction	3
5.	Preparation of benzhydrol by NaBH4 reduction of benzophenone	3
6.	Synthesis of acetanilide from aniline	3
7.	Preparation of $[Ni(NH_3)_6]^{2+}$ & Ni estimation (Complexometrical & Gravimetrical)	3
8.	Preparation of Ni or Co-Acetylacetonate	3
9.	Preparation of a Metal Complex with a Multidentate Ligand: Preparation of Polynuclear Thiourea Complex of Copper (I)	3
10.	Recycling of Aluminum: Preparation of Potash Alum from waste Aluminum	3
11.	Estimation of Barium ion in Barium sulfate	3
12.	Blueprinting: Study of Photochemical Reduction of a Ferric salt.	3
13.	Determination of spectrochemical order of ligands by using electronic spectroscopy of Nickel(II) coordination complexes.	3
14.	The Suzuki-Miyaura reaction: Synthesis of 4-nitro-1,1'-biphenyl compound	3
	Total number of hours	**42**

Suggested Reading: (Please use the format: Author(s) (Surname first), Title, Publisher, Year of publication.

1) Practical Organic Chemistry, 5th Edition, 1989, Vogel, Arthur Israel. Vogel's textbook of practical organic chemistry
2) Lab Manual, DCS, IISER Berhampur.
3) Infrared and Raman Spectra: Inorganic and coordination Compounds, Sixth Edition Part A & B; K.Nakamoto; John Wiley & Sons, Inc., New Jersey, 2009.

Modalities for Students Performance Assessment (with details of weightage for different components of performance assessment within the broad guidelines given in BS-MS/PhD manual):

Continuous laboratory assessment, laboratory record writing and laboratory examinations including viva-voce (the weightage of these components will be as per the Institute BS-MS manual).

Additional Guidelines:

Suggested to perform 12 Experiments out of a library of 14 experiments mentioned in the course content. Time to teach the theory parts associated with the experiments and discussions regarding the same are included in the total hours.

Name and Signature of course proposer(s): **The Departmental UG Committee, DCS.**

Similarity with the existing courses, if any: Nil

(Similarity content is declared as per the number of lecture hours on similar topics)

S. No.	Name of the Course	Course Code	Similarity Content	Approx. % of Content
1.				
2.				

Justification of new course proposal if cumulative similarity content is >30%: NA

Recommendation of External experts/Senate members/Subject expert(s)

Description (Add separate sheet, if required)	Description (Add separate sheet, if required)

The above proposal followed by the recommendations of the External experts/Senate members/Subject expert(s) appointed by Director is found to be acceptable by the DUGC/DPGC in its meeting held on_____. The committee recommended the introduction of new course for consideration of CoAA/DoAA and Director/Chairperson Senate.

Convener, DUGC Convener, DPGC	FIC/HoD

For Use of the Academic Section

Recommended/Not Recommended to Senate Chairperson	Coordinator/Dean, Academic Affairs

Recommended / Not Recommended for the approval/ratification by the Senate

Director/Chairperson Senate

Indian Institute of Science Education and Research Berhampur

Proposal of a New Course

Department of Chemical Sciences

Course Title	**Laboratory for Physical Methods in Chemistry**				
Course Level (tick (√) in the relevant option)	100 ☐ 200 ✓☐ 300 ☐ 400 ☐ 500 ☐ 600 ☐ 700 ☐			Semester: Odd ☐ Even ✓☐ Either semester ☐	
Course applicable for	BSMS ✓☐ Int. PhD. ☐ Ph.D. ☐				
Tag of the course (tick (√) in the relevant option(s))	Institute Core ✓☐ Professional (Department) Core ☐ Department Elective ☐ Open Elective ☐ Minor ☐				
Type of the course	Theory ☐ Lab ✓☐ Project ☐ Non-Credit ☐				
Credit Structure	Lectures (L)	Tutorials (T)	Practicals (P)	Total Credits	
	0	0	3	1	
Course Code:	**CH204**				
Names of faculties who can teach the course	**All of the existing faculty members of the Department of Chemical Sciences can teach this course.**				
Will the course require participation of visiting faculties: ~~Yes~~ / No					
Prerequisites, if any Course code(s)	Nil				

Learning Objective(s):

The objective of this course is to introduce the students to the basic physical analysis/characterization techniques, which will be useful across various branches of Chemistry as well as in other disciplines.

Expected Learning Outcome(s):

After completing this course, the students will gain hands-on knowledge on Laboratory experiments covering fundamental concepts in various instrumental techniques including different characterization methods such as NMR, IR, mass spectra, UV-Visible absorption etc.

Contents of the course:

1. Acidic and basic dissociation constants of glycine and its isoelectric point.
2. Determination of dissociation constant and equivalent conductance at infinite dilution of weak electrolyte (acetic acid) using conductometry.
3. Kinetics of the iodide-hydrogen peroxide clock reaction.
4. Potentiometric Titration of a standard solution of KCl against $AgNO_3$ – Determination of solubility product of AgCl.
5. Potentiometric Titration of a standard solution of $AgNO_3$ against mixture of halides – Determination of concentration of two salts in a given mixture.
6. First order kinetics – Acid hydrolysis of methyl acetate at different temperatures taking different concentrations of [H+] ions.
7. Analysis of mass spectra of simple organic molecules.
8. Functional group (carbonyl, nitro, ester, amide, alcohol, etc.) determination by IR spectroscopy.
9. UV-Visible absorption and fluorescence spectra for a standard dye molecule.
10. Identification of 1H NMR of a small molecule (ethylbenzoate or aspirin).
11. Measurement of optical rotations of two enantiomers, *d*-tartaric acid and *l*-tartaric acid.
12. Characterization of a paramagnetic compound ($CuSO_4$/$MnCl_2$) by EPR spectroscopy.
13. Determination of redox potentials of Ferrocene through cyclic voltammetry.
14. Analysis of the crystalline structure of a compound (PXRD: NaCl/KCl/PPh3, SXRD: benzoic acid) by X-ray diffraction (powder/single crystal).

Lecture Outline: (Not more than 6 lectures per module) **NA**

Module No	Topic	No. of Hours

Brief Description of Tutorial Activities: NA

Module No	Topic	No. of Hours

Brief Description of Laboratory Activities:

Experiment No:	Topic	No. of Hours
1.	Acidic and basic dissociation constants of glycine and its isoelectric point	3
2.	Determination of dissociation constant and equivalent conductance at infinite dilution of weak electrolyte (acetic acid) using conductometry	3
3.	Kinetics of the iodide-hydrogen peroxide clock reaction	3
4.	Potentiometric Titration of a standard solution of KCl against $AgNO_3$ – Determination of solubility product of AgCl	3
5.	Potentiometric Titration of a standard solution of $AgNO_3$ against mixture of halides – Determination of concentration of two salts in a given mixture	3
6.	First order kinetics – Acid hydrolysis of methyl acetate at different temperatures taking different concentrations of [H+] ions	3
7.	Analysis of mass spectra of simple organic molecule	3
8.	Functional group (carbonyl, nitro, ester, amide, alcohol, etc.) determination by IR spectroscopy	3
9.	UV-Visible absorption and fluorescence spectra for a standard dye molecule	3
10.	Identification of 1H NMR of a small molecule (ethylbenzoate or aspirin)	3
11.	Measurement of optical rotations of two enantiomers, *d*-tartaric acid and *l*-tartaric acid	3
12.	Characterization of a paramagnetic compound ($CuSO_4$/$MnCl_2$) by EPR spectroscopy	3
13.	Determination of redox potentials of Ferrocene through cyclic voltammetry	3
14.	Analysis of the crystalline structure of a compound (PXRD: NaCl/KCl/PPh_3, SXRD: benzoic acid) by X-ray diffraction (powder/single crystal)	3
	Total number of hours	**42**

Suggested Reading: (Please use the format: Author(s) (Surname first), Title, Publisher, Year of publication.

Lab Manual, DCS, IISER Berhampur.

Modalities for Students Performance Assessment (with details of weightage for different components of performance assessment within the broad guidelines given in BS-MS/PhD manual):

Continuous laboratory assessment, laboratory record writing and laboratory examinations including viva-voce (the weightage of these components will be as per the Institute BS-MS manual).

Additional Guidelines:

Suggested to perform 12 Experiments out of a library of 14 experiments mentioned in the course content. Time to teach the theory parts associated with the experiments is included in the total hours.

Name and Signature of course proposer(s):

The Departmental UG Committee, DCS.

Similarity with the existing courses, if any: Nil

(Similarity content is declared as per the number of lecture hours on similar topics)

S. No.	Name of the Course	Course Code	Similarity Content	Approx. % of Content
1.				
2				

Justification of new course proposal if cumulative similarity content is >30%: NA

Recommendation of External experts/Senate members/Subject expert(s)

Description (Add separate sheet, if required)	Description (Add separate sheet, if required)

The above proposal followed by the recommendations of the External experts/Senate members/Subject expert(s) appointed by Director is found to be acceptable by the DUGC/DPGC in its meeting held on_____. The committee recommended the introduction of new course for consideration of CoAA/DoAA and Director/Chairperson Senate.

Convener, DUGC Convener, DPGC	FIC/HoD

For Use of the Academic Section

Recommended/Not Recommended to Senate Chairperson	Coordinator/Dean, Academic Affairs

Recommended / Not Recommended for the approval/ratification by the Senate

Director/Chairperson Senate

Indian Institute of Science Education and Research Berhampur

Proposal of a New Course

Department of Chemical Sciences

Course Title	**Physical Chemistry I**				
Course Level (tick (√) in the relevant option)	100 ☐ 200 ✓☐ 300 ☐ 400 ☐ 500 ☐ 600 ☐ 700 ☐			Semester: Odd ☐ Even ✓☐ Either semester ☐	
Course applicable for	BSMS ✓☐ Int. PhD. ☐ Ph.D. ☐				
Tag of the course (tick (√) in the relevant option(s))	Institute Core ✓☐ Professional (Department) Core ☐ Department Elective ☐ Open Elective ☐ Minor ☐				
Type of the course	Theory ✓☐ Lab ☐ Project ☐ Non-Credit ☐				
Credit Structure	Lectures (L)	Tutorials (T)	Practicals (P)	Total Credits	
	3	0	0	3	
Course Code:	**CH206**				
Names of faculties who can teach the course	**All of the existing faculty members of the Department of Chemical Sciences with Physical Chemistry background can teach this course.**				
Will the course require participation of visiting faculties: ~~Yes~~ / No					
Prerequisites, if any Course code(s)	Nil				

Learning Objective(s):

To introduce students to the basic mechanisms of the transformation of energy into different forms, transformation between different physical states/phases and their relation to physical observables such as temperature, pressure, and volume.

Expected Learning Outcome(s):

After completing the course, students will gain knowledge regarding fundamental concepts of laws of thermodynamics, chemical equilibrium, phase equilibrium, phase rules and colligative properties, and will be able to solve related problems.

Contents of the course:

1st Law of thermodynamics and thermochemistry, 2nd Law of thermodynamics, concept of entropy. Introduction to 3rd law of thermodynamics. Spontaneity and equilibrium, chemical equilibrium, phase equilibrium and phase diagrams for single-component systems, phase rule, Solutions and colligative properties.

Lecture Outline: (Not more than 6 lectures per module)

Module No	Topic	No. of Hours
1.	**1st Law of thermodynamics and thermochemistry:** Heat capacity at constant volume (c_v) and constant pressure (c_p) and their relation, Joule's experiment, Joule's coefficient for ideal and van der Waals gas, Joule-Thomson experiment, Joule-Thomson coefficient for ideal and van der Waals gas, Adiabatic changes in state, standard enthalpy of physical and chemical changes, Hess's law, Standard enthalpies of formation, temperature dependence of reaction enthalpies, calorimetry.	5
2.	**2nd Law of thermodynamics:** Kelvin and Clausius statement of 2nd law, Carnot cycle, Heat engine and refrigerator, efficiency of heat engine, Clausius inequality.	4
3.	**Concept of entropy:** Properties of entropy, entropy changes in isothermal processes, cyclic rule and its applications, entropy changes in relation to	4

	changes in the state variables, entropy as a function of temperature and volume, entropy as a function of temperature and pressure, temperature dependence of the entropy, entropy changes in an ideal gas, entropy changes in chemical reactions.	
4.	**Introduction to 3rd law of thermodynamics:** 3rd law of thermodynamics, entropy and probability, Boltzmann equation, entropy of mixing (using concept of microstates) and exception to the 3rd law of thermodynamics.	3
5.	**Spontaneity and equilibrium:** Entropy and irreversibility, general condition for spontaneity and for equilibrium, the fundamental equations of thermodynamics, Maxwell relations, thermodynamic equation of state and its applications, properties of Gibbs free energy, temperature dependence of Gibbs free energy and Gibbs-Helmholtz equation.	4
6.	**Chemical equilibrium:** Definition and properties of chemical potential, partial molar quantities, Gibbs free energy and entropy of mixing, chemical equilibrium in a mixture, advancement of a chemical reaction, chemical equilibrium in a mixture of ideal gases, equilibrium constant, interrelations between K_p, K_c and K_x, effect of temperature and pressure on equilibrium constant, le Chatelier principle, Gibbs-Duhem equation.	4
7.	**Phase equilibrium and phase diagrams for single-component systems:** Stability of phases of a pure substance, change of chemical potential with temperature and pressure, Clapeyron equation, different kind of phase equilibria: solid-liquid, liquid-gas and solid-gas, phase diagram of single-component systems such as water, CO_2, sulfur, Clausius-Clapeyron equation.	3
8.	**Phase rule:** Phase rule of single and multi-component systems: derivation and applications.	3
9.	**Solutions and colligative properties:** Ideal and non-ideal solutions, Raoult's law, colligative properties: freezing point depression, boiling point elevation, osmotic pressure.	6
10.	**General discussions and doubt clearing**	6
	Total number of hours	**42**

Brief Description of Tutorial Activities: NA

Module No	Topic	No. of Hours

Brief Description of Laboratory Activities: NA

Experiment No:	Topic	No. of Hours

Suggested Reading: (Please use the format: Author(s) (Surname first), Title, Publisher, Year of publication.

1. Atkins, P.W., de Paula, J., Physical Chemistry, Ed. 9th, Oxford Press, **2009**.
2. Castellan, G.W., Physicsl Chemistry, Ed. 3rd, Narosa Publishing House, **2004**.
3. Levine, I., Physical Chemistry, Ed. 6th, McGraw Hill, **2009.**
4. Berry, R.S., Rice, S.A., Ross, J., Physical Chemistry, Ed. 2nd, Oxford Press, **2000**.

Modalities for Students Performance Assessment (with details of weightage for different components of performance assessment within the broad guidelines given in BS-MS/PhD manual):

Continuous assessment (class test, assignments, quiz, etc.), mid-Semester and end-Semester examinations (the weightage of these components will be as per the Institute BS-MS manual).

Additional Guidelines:

There must be 5-6 hours of discussion and doubt clearing sessions throughout the course. If required, tutorials should be taken separately, outside the lecture hours.

Name and Signature of course proposer(s):

The Departmental UG Committee, DCS.

Similarity with the existing courses, if any:

(Similarity content is declared as per the number of lecture hours on similar topics)

S. No.	Name of the Course	Course Code	Similarity Content	Approx. % of Content
1.	Fundamentals of Physics I	PS101	6 hours	14%

Justification of new course proposal if cumulative similarity content is >30%: NA

Recommendation of External experts/Senate members/Subject expert(s)

Description (Add separate sheet, if required)	Description (Add separate sheet, if required)

The above proposal followed by the recommendations of the External experts/Senate members/Subject expert(s) appointed by Director is found to be acceptable by the DUGC/DPGC in its meeting held on_____. The committee recommended the introduction of new course for consideration of CoAA/DoAA and Director/Chairperson Senate.

Convener, DUGC Convener, DPGC	FIC/HoD

For Use of the Academic Section

Recommended/Not Recommended to Senate Chairperson	Coordinator/Dean, Academic Affairs
Recommended / Not Recommended for the approval/ratification by the Senate Director/Chairperson Senate	

Indian Institute of Science Education and Research Berhampur

Proposal of a New Course

Department of Chemical Sciences

Course Title	**Inorganic Chemistry I**				
Course Level (tick (√) in the relevant option)	100 ☐ 200 ✓☐ 300 ☐ 400 ☐ 500 ☐ 600 ☐ 700 ☐			Semester: Odd ✓☐ Even ☐ Either semester ☐	
Course applicable for	BSMS ✓☐ Int. PhD. ☐ Ph.D. ☐				
Tag of the course (tick (√) in the relevant option(s))	Institute Core ✓☐ Professional (Department) Core ☐ Department Elective ☐ Open Elective ☐ Minor ☐				
Type of the course	Theory ✓☐ Lab ☐ Project ☐ Non-Credit ☐				
Credit Structure	Lectures (L)	Tutorials (T)	Practicals (P)	Total Credits	
	3	0	0	3	
Course Code:	**CH205**				
Names of faculties who can teach the course	**All of the existing faculty members of the Department of Chemical Sciences with Inorganic Chemistry background can teach this course.**				
Will the course require participation of visiting faculties: ~~Yes~~ / No					
Prerequisites, if any Course code(s)	Nil				

Learning Objective(s):

The concepts related to a fundamental understanding of Inorganic Chemistry such as bonding, structure, and periodic properties of elements are covered in this basic course.

Expected Learning Outcome(s):

At the end of this course, students will gain basic knowledge of the elements, their periodic trends, and relation to observed properties. Additionally, this course will impart in-depth knowledge on structure, and bonding in inorganic compounds.

Contents of the course:

Main group Chemistry: General characteristics of s-, and p-block elements, electron-deficient molecules, hyper-valency concept, main group organometallics. Transition metal complexes: Types of ligands and stereochemistry, Preliminary idea about crystal field theory (CFT), Application of CFT to explain color and magnetism of transition metal complexes, concept of 18 electron rule among transition metal complexes, preliminary ideas about the relationship of transition metal complexes and metalloenzymes. Chemistry of f-block elements: Periodic properties of rare earth elements.

Lecture Outline: (Not more than 6 lectures per module)

Module No	Topic	No. of Hours
	Main group chemistry	
1.	General characteristics of s-, and p-block elements (hydrides, oxides, and halides)	5
2.	Electron-deficient molecules, hyper-valency, concept of multi-centered bonding, and Lewis acid-base concepts.	3
3.	Main group organometallics: : Organometallic reagents involving lithium, magnesium, and aluminum.	5

	Transition metal complexes	
4.	General characteristics of transition metals and variable oxidation states. Types of ligands and stereochemistry of complexes.	3
5.	Preliminary idea about crystal field theory (CFT): splitting of d-orbital energy levels for Oh, Td, and square planar complexes	4
6	Application of CFT to explain color and magnetism of transition metal complexes, spectrochemical series.	3
7.	Concept of 18 electron rule based on MO theory among transition metal complexes,	4
8	Introduction to organometallic chemistry, different aspects of ligands and bonding modes of ligands (sigma and pi-ligands).	4
8.	Preliminary ideas about the relationship of transition metal complexes and metalloenzymes.	3
	Chemistry of f-block elements	
9.	Periodic properties of rare earth elements (RRE), extraction and separation of REE, and their applications.	3
10.	General discussion and doubt clearing	5
	Total number of hours	**42**

Brief Description of Tutorial Activities: NA

Module No	Topic	No. of Hours

Brief Description of Laboratory Activities: NA

Experiment No:	Topic	No. of Hours

Suggested Reading: (Please use the format: Author(s) (Surname first), Title, Publisher, Year of publication.

1) Inorganic Chemistry, Shriver and Atkins, Fourth Edition, Oxford University Press, 2006. Concise Inorganic Chemistry, J. D. Lee, Fifth Edition, Blackwell Publishing, 2006.
2) Basic Inorganic Chemistry, F. A. Cotton, G. Wilkinson, P. L. Gaus, Third Edition, John Wiley and Sons Press, 1995.
3) Concepts and Models of Inorganic Chemistry, B. Douglas, D. McDaniel, J. Alexander, Wiley India (P.) Ltd., India,2010.
4) Inorganic Chemistry-Principles of Structure and Reactivity. J. E. Huheey, E. A. Keiter, R. L. Keiter, 4th Edn. Harper-Collins, NY, 1993.

Modalities for Students Performance Assessment (with details of weightage for different components of performance assessment within the broad guidelines given in BS-MS/PhD manual):

Continuous assessment (class test, assignments, quiz etc), mid-Semester and end-Semester examinations (the weightage of these components will be as per the Institute BS-MS manual).

Additional Guidelines:

There must be 5-6 hours of discussion and doubt clearing sessions throughout the course. If required, tutorials should be taken separately, outside the lecture hours.

Name and Signature of course proposer(s):

The Departmental UG Committee, DCS.

Similarity with the existing courses, if any: Nil

(Similarity content is declared as per the number of lecture hours on similar topics)

S. No.	Name of the Course	Course Code	Similarity Content	Approx. % of Content
1.				
2.				

Justification of new course proposal if cumulative similarity content is >30%: NA

Recommendation of External experts/Senate members/Subject expert(s)

Description (Add separate sheet, if required)	Description (Add separate sheet, if required)

The above proposal followed by the recommendations of the External experts/Senate members/Subject expert(s) appointed by Director is found to be acceptable by the DUGC/DPGC in its meeting held on_____. The committee recommended the introduction of new course for consideration of CoAA/DoAA and Director/Chairperson Senate.

Convener, DUGC Convener, DPGC	FIC/HoD

For Use of the Academic Section

Recommended/Not Recommended to Senate Chairperson	

	Coordinator/Dean, Academic Affairs
Recommended / Not Recommended for the approval/ratification by the Senate Director/Chairperson Senate	