COURSE DESCRIPTION M.Sc. CHEMISTRY

Semester I

Physical Chemistry

Title: Physical Chemistry **Code: 12M11CH101**

L-T-P Scheme: 3-1-0 **Credit: 4**

Prerequisite: The students must be aware of Electrochemistry, Kinetics, Surface Chemistry, and Radiation Chemistry up to the graduate level. This knowledge helps them to correlate and adopt at Master Level (Post Graduate).

Objective:

The purpose behind this course is to make the students upgrade the concepts and analyze their application in the commercial and applied level of Chemistry. The objective of this course is to prepare students ready for the future in Energy, Battery, Enzyme, and Chemical Industry.

Course Learning Outcomes:

Course Outcome	Description
CO1	The outline, outcomes, and attributes provide students with learning experiences that help in achieving deep interests in learning Electrochemistry, Kinetics, Surface Chemistry, and Radiation Chemistry. It will develop broad and balanced knowledge and understanding of the concepts of key chemical, principles, and theories related to Physical Chemistry; and equip students with appropriate tools of analysis to tackle issues and problems in the field of Physical chemistry.
CO2	Describe the real-world problems, challenges with the application of the Electrochemistry, Kinetics, Surface Chemistry, and Radiation Chemistry.
CO3	Develop in students the ability to apply the knowledge and skills they have acquired to the solution of specific theoretical and applied problems in Electrochemistry, Kinetics, Surface Chemistry, and Radiation Chemistry.
CO4	Identify and use various analytical techniques in Electrochemistry, Kinetics, Surface Chemistry, and Radiation Chemistry based project management.
CO5	Apply experimental demonstration and validation by using various analytical techniques given in theorem, principles as explained in lectures.

CO6 Demonstrate students with the knowledge and skill base that would enable them to undertake further studies in Electrochemistry, Kinetics, Surface Chemistry, and Radiation Chemistry. It helps to develop a range of generic skills that are relevant to wage employment, self-employment, and entrepreneurship.

COURSE CONTENT

Unit 1: Electrochemistry:

Metal/Electrolyte interface: OHP and IHP, potential profile across double layer region, the potential difference across electrified interface; Structure of the double layer: Helmholtz-Perrin, Gouy- Chapman, and Stern models. Butler-Volmer equation under near equilibrium and non-equilibrium conditions, exchange current density, Tafel plot. Polarizable and non-polarizable interfaces. Semiconductor (SC)/electrolyte interface: Creation of space charge region, Capacity of space-charge, Mott-Schottky plot for the n-type and p-type semiconductors, determination of flat-band potential, and donor/acceptor densities. Application of SC/electrolyte interface in solar cells.

Unit 2: Chemical Kinetics:

Mechanism of Composite Reactions - Types of composite mechanism, rate equations for a composite mechanism, simultaneous and consecutive reactions. Steady-state treatment, rate-determining steps, microscopic reversibility, dynamic chain (H2-Br2 reaction, decomposition of ethane and acetaldehyde), and oscillatory reactions (Belousov-Zhabotinskii reaction), branching chain: H_2+O_2 reaction.

Unit 3: Surface Chemistry and Catalysis:

Bimolecular surface reactions - reaction between a gas molecule and an adsorbed molecule, the reaction between two adsorbed molecules, inhibition and activation energy. Catalytic activity at surfaces (volcano curve), the transition state theory of surface reactions: rates of chemisorption and desorption, unimolecular and bimolecular surface reaction, comparison of homogeneous and heterogeneous reaction rates, surface heterogeneity, lateral interaction.

Unit 4: Radiation Chemistry and measurement of radiations:

Interaction of nuclear radiation with matter, charged particles, neutrons, and gamma-rays. Unit of radiation absorption, radiation dosimetry, radiolysis of water and some aqueous solutions, Ionization chamber, electron-pulse counters, electron multiplication in a gas, secondary processes, variation of pulse size with voltage, Types of G-M counters, absolute disintegration rate, Scintillation detector, semiconductor detectors, Neutron detectors.

Teaching Methodology:

This syllabus has been implemented for helping the students to understand structure Electrochemistry, Kinetics, Surface Chemistry, and Radiation Chemistry. The entire syllabus has divided into four units. Each section includes multiple topics to help a student gain a deeper understanding of Physical Chemistry. This course is divide into 42 Lectures, 14 Tutorial, and 14

Experiments. The facility provided in LRC for both textbooks of ebook for getting a better understanding of students. The NPTEL lecture was also made available to students.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1 and Unit-2
Test-2	25 Marks	Based on Unit-2 & Unit-3 (80 %) and around 20% from coverage of Test-1
Test-3	35 Marks	Based on Unit-3 to Unit-4 (80%) and around 20% from coverage of Test-1 and Text-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slide on Web Development (will be added from time to time): Digital copy will be available on the JUET server.

Text Book:

[1] Modern Electrochemistry, Vol. 2 A & B, J.O'M. Bockris and A. K. N. Reddy, 2nd Ed. Plenum Press, New York (1998).

[2] Chemical Kinetics, K. J. Laidler, 3rd Ed. (1987), Harper & Row, New York.

[3] Physical Chemistry, P. W. Atkins, 7th & 8th Eds., Oxford University Press, New York.

Reference Book:

[1] Physical Chemistry, I.N. Levine, 5th Ed., Tata McGraw Hill Pub. Co. Ltd., New Delhi.

[2] Essentials of Nuclear Chemistry, H.J. Arnikar, 4th Ed. Wiley-Eastern Ltd., New Delhi.

Organic Chemistry

Title: Organic Chemistry **Code: 12M11CH102**

L-T-P Scheme: 3-1-0 **Credit: 4**

Prerequisite: The students must be aware of Organic Chemistry up to the graduate level. This knowledge will help to achieve excellence in the identification and characterization of organic compounds as well as excel in heterocyclic organic compounds.

Objective:

This course will help the students to upgrade their concepts of structure and reactivity of aromatic compounds. It also helps in learning of Stereochemistry and Stereoisomerism of hexacyclic & cyclic organic compounds. It also elucidates the heterocyclic compounds, synthesis, and their characterization.

Course Learning Outcomes:

Course Outcome	Description
CO1	The outline, outcomes, and attributes provide students with learning experiences in Organic Chemistry. It develops broad and balanced knowledge and understanding of synthesis and characterizations. Further, it equips students with appropriate tools of analysis to tackle issues and problems in the field of Organic Chemistry.
CO2	Describe the real-world problems and challenges through applications of the aromatic, non-aromatic, and heterocyclic organic compounds.
CO3	Develop in students the ability to apply the knowledge and skills they have acquired to the solution of specific theoretical and applied problems in synthesis and characterization of the organic compound.
CO4	Identify and use various analytical techniques in synthesis and characterization of the organic compound to effectively uses in Project Management.
CO5	Apply experimental demonstration and validation by using various analytical techniques given in theorem, principles as explained in lectures.
CO6	Demonstrate students with the knowledge and skill base that would enable them

to undertake further studies in synthesis and characterization of the organic compound. It helps to develop a range of generic skills that are relevant to wage employment, self-employment, and entrepreneurship.

Teaching Methodology:

This course has been introducing to help students understanding the structure, reactivity, stereochemistry of Organic compounds. It also deals with a few natural products considering their importance in medicine and the synthetic industry. The entire course has been broking down into four units. Each section includes multiple topics to help a student gain a deeper understanding of Organic Chemistry. This course has been dividing into 42 Lectures, 14 Tutorial, and 12 Experiments. The facility provided in LRC for both textbooks of ebook for getting a better understanding of students. The NPTEL lecture was also made available to students.

COURSE CONTENT

Unit 1: Structure and reactivity:

Localized and delocalized covalent bond - Concept of resonance and aromaticity - Huckel's rule for aromaticity in benzenoid and non-benzenoid compounds, antiaromaticity and homo-aromaticity. Nature of reaction energy and kinetic considerations - types of organic reactions - reagents - reactive intermediates. Their formation and stabilization - inductive and mesomeric effects.

Unit 2: Stereochemistry and stereoisomerism.

Conformational isomerism and analysis in acyclic and simple cyclic systems - substituted ethanes, cyclopentane, cyclohexane cycloheptane, cyclo octane, and decane, optical isomerism - optical activity - molecular dissymmetry and chirality - elements of symmetry. Fisher's projection D, L., and R, S. configurations - relative and absolute configurations optical isomerism due to asymmetric carbon atoms - optical isomerism in biphenyls, allenes, and spirans - optical isomerism of nitrogenous compounds racemization and resolution – geometrical isomerism and E, Z configurations, properties of geometrical isomers.

Unit 3: Chemistry of heterocyclic compounds, synthesis, and reactivity of the following systems: Pyridine, quinoline, Isoquinoline, Indole, Benzofuran, Benzothiophene - Pyrazole, Imidazole, Oxazole, Isoxazole, Thiazole, Isothiazole, Pyridazine, pyrimidine, and Pyrazine.

Unit 4: Chemistry of some typical natural products.

A study of the following compounds involving their isolation, structure elucidation, synthesis, and biogenesis - flavonoids - quercetin, cyanidin and genistein, terpenoids, α- terpeneol an α - pinene, camphor, farnesol.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1 and Unit-2
Test-2	25 Marks	Based on Unit-2 & Unit-3 (80 %) and around 20% from coverage of Test-1
Test-3	35 Marks	Based on Unit-3 to Unit-4 (80%) and around 20% from coverage of Test-1 and Text-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slide on Web Development (will be added from time to time): Digital copy will be available on the JUET server.

Textbooks:

[1] Organic Chemistry Vol I (Sixth Edn.) and Vol. II (Fifth Ed.,) by I L finar ELBS.
[2] Organic Chemistry (fifth Edn.,) by Morrison and Boyd, PHI, India.
[3] Organic Chemistry (fifth edition)by Francis A. Carey Tata Mc Graw Hill publishing company Limited, New Delhi.
[4] Reaction Mechanism in Organic Chemistry by Mukherjee Sirigh, NTerniitarr, India
[5] A guide book to mechanism in Organic Chemistry by Peter Sykes, ELBS.

Reference Book:

[1] Advanced organic chemistry by Jerry March (4th Edition) Wiley Eastern.
[2] Chemistry of Natural Products, K.W.Bentley by
[3] Stereochemistry of carbon compounds by E.Eliel, John Wiley &Sons, Inc.
[4] Stereochemistry of Organic compounds by D. Nasipuri.
[5] Chemistry of Natural products by R.S. Kalsi Kalyani Publishers. 1983.

Inorganic Chemistry

Title: Inorganic Chemistry **Code: 12M11CH103**

L-T-P Scheme: 3-1-0 **Credit: 4**

Prerequisite: The students must be aware of Transition and Inner-Transition metal Chemistry up to graduate level. This knowledge helps them to learn in-depth synthesis and characterization of Transition and Inner-Transition metal complex compounds.

Objective:

The purpose behind this course is to make the students upgrade the concepts and analyze their application in the commercial and applied level (Inorganic compound). The objective of this course is to prepare students ready for the future in Energy, Nanomaterial, Enzyme, and Chemical industries.

Course Learning Outcomes:

Course Outcome	Description
CO1	The outline, outcomes, and attributes provide students with learning experiences that help instill deep interests in learning. It develops broad and balanced knowledge and understanding of key-chemical concepts, principles, and theories related to transition and inner-transition metal; and equip students with appropriate tools of analysis to tackle issues and problems in the field of Inorganic Chemistry.
CO2	Describe the real-world problems, challenges with the application of the metal-ligand bonding, biological molecules containing transition, and inner-transition metals.
CO3	Develop in students the ability to apply the knowledge and skills they have acquired to the solution of specific theoretical and applied problems in Energy, Nanomaterial, Enzyme, and Chemical industries.
CO4	Identify and use various analytical techniques in Energy, Nanomaterial, Enzyme, and Chemical Industry.
CO5	Apply experimental demonstration and validation by using various analytical techniques given in theorem, principles as explained in lectures.
CO6	Demonstrate students with the knowledge and skill base that would enable them to undertake further studies in Inorganic Chemistry helps to develop a range of generic

skills that are relevant to wage employment, self-employment, and entrepreneurship.

Teaching Methodology:

This course has been introducing to help students to understand Transition and Inner-Transition metal Chemistry. It has divided into five units. Each section includes multiple topics to help a student gain a deeper understanding of the Inorganic Chemistry. This course has divided into 42 Lectures, 14 Tutorial, and 12 Experiments. The facility provided in LRC for both textbooks and ebook for getting better understanding in students. The NPTEL lecture was also made available to students.

COURSE CONTENT

Unit 1: Metal-Ligand Bonding in Transition Metal Complexes:

Survey of the transition elements. General characteristics of transition elements. Electronic configurations and oxidation states. Valence bond theory and its limitations. Ligand field theory: Splitting of d orbitals in different ligand fields Crystal field splitting diagrams in complexes of low symmetry; Spectrochemical and Nephelauxetic series; thermodynamic and structural effects; site selection in spinels, Jahn-Teller distortions; experimental evidence for metal-ligand orbital overlap; ligand field theory, the molecular orbital theory of octahedral complexes.

Unit 2: Electronic Spectra of Transition Metal Complexes:

Spectroscopic ground states; Orgel energy level and Tanabe-Sugano diagrams for transition metal complexes; Charge transfer spectra; electronic spectra of octahedral and tetrahedral Co(II) and Ni(II) complexes and calculation of ligand-field parameters.

Unit 3:

Study of the following groups of elements and their compounds with peculiar structures, and their recent chemistry-Ti, Zr and Hf

Unit 4: Lanthanides:

Characteristic properties. Electronic configurations and term symbols.

Unit 5: Actinides:

Occurrence and general properties. Electronic configuration

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1 and Unit-2
Test-2	25 Marks	Based on Unit-2 & Unit-3 (80 %) and around 20% from coverage of Test-1
Test-3	35 Marks	Based on Unit-3 to Unit-4 (80%) and around 20% from coverage of Test-1 and Text-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slide on Web Development (will be added from time to time): Digital copy will be available on the JUET server.

Books Recommended

1. F.A. Cotton and G. Wilkinson Advanced Inorganic Chemistry, 6th Edn. (1999), John Wiley &Sons, New York.
2. James E. Huheey, Inorganic Chemistry, 4th Edn. (1993), Addison-Wesley Pub. Co., New york
3. R. S. Drago, Physical Methods in Inorganic Chemistry, International Edn. (1971), Affiliated East-West Press, New Delhi.
4. Keith F. Purcell and John C. Kotz, Inorganic Chemistry, W. B. Sauders Com. (1987), Hong
   Kong.5. K. Veera Reddy, Symmetry and Spectroscopy of Molecules, New Age International Pvt. Ltd., New Delhi (1999).
5. B.N. Figgis, Introduction to Ligand Fields, Wiley Eastern Ltd. New Delhi (1976).

Analytical Chemistry

Title: Analytical Chemistry **Code: 21M11CH104**

L-T-P Scheme: 2-1-0 **Credit: 3**

Prerequisite: The students must be aware of basic Inorganic, Physical and Organic Chemistry up to the graduate level. This knowledge helps them to correlate and adopt at Master Level (Post Graduate).

Objective:

Fundamental understanding on the principle of operation, sources of error and correct interpretation of results using appropriate analytical techniques will be aimed.

Course Learning Outcomes:

Course Outcome	Description
CO1	The outline, outcomes, and attributes provide students with learning experiences that help in achieving deep interests in learning. Students will be learns the various Analytical Technique for application in advance chemistry.
CO2	Describe the real-world problems, challenges with the application of the Analytical Chemistry. Advanced analytical techniques along with the instrumentation part will enable students to perform optimal use of these techniques efficiently to their advantage and will be useful for getting in chemical industries.
CO3	Develop in students the ability to apply the knowledge and skills they have acquired to the solution of specific theoretical and applied problems in Chemistry.
CO4	Identify and use various analytical techniques in characterization and application.
CO5	Apply experimental demonstration and validation by using various analytical techniques given in theorem, principles as explained in lectures.
CO6	Demonstrate students with the knowledge and skill base that would enable them to undertake further studies. It helps to develop a range of generic skills that are relevant to wage employment, self-employment, and entrepreneurship.

COURSE CONTENT

Unit 1

Analytical techniques (Instrumentation and Applications)

(i) **Electroanalytical methods:-** Polarography (DC, AC and pulse), cyclic voltammetry, coulometry and anode stripping voltammetry.

(ii) **Optical methods:-** UV/Visible, X-ray photoelectron spectroscopy (XPS), Auger Electron Spectroscopy (AES), ESCA, Atomic absorption and emission spectroscopy.

(iii) Infrared Spectroscopy, Dispersive and Fourier Transformed Raman, Resonance Raman and Surface Enhanced Raman Spectroscopy- Dispersive and Fourier Transformed.

(iv) **Hifanated Techniques:** GC-IR, TG-IR Spectroscopy, GC-Mass Spectroscopy (v) Imaging Techniques: Electron microscopy (SEM, TEM)

Unit 2:

Diffraction, Separation and Thermal Methods

(i) Diffraction Methods: Single crystal and Powder X–Ray Diffraction and their applications for Inorganic Compounds, Neutron Diffraction and Electron Diffraction.

(ii) Separation Methods: Theory and applications of separation methods in analytical chemistry: solvent extraction, ion exchangers including liquid ion exchangers and chromatographic methods for identification and estimation of multicomponent systems (such as TLC, GC, HPLC, etc.).

(iii)Thermal Methods: TG, DTA, DSC and thermometric titrations.

Teaching Methodology:

This syllabus has been implemented for helping the students to understand the various Analytical Technique for analysis of chemical compound. The entire syllabus has divided into two units. Each section includes multiple topics to help a student gain a deeper understanding. This course is dividing into 28 Lectures and 14 Tutorial. The facility provided in LRC for both textbooks of ebook for getting a better understanding of students. The NPTEL lecture was also made available to students.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1 and Unit-2

Test-2	25 Marks	Based on Unit-2 & Unit-3 (80 %) and around 20% from coverage of Test-1
Test-3	35 Marks	Based on Unit-3 to Unit-4 (80%) and around 20% from coverage of Test-1 and Text-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slide on Web Development (will be added from time to time): Digital copy will be available on the JUET server.

Text Books:

[1] West, A.R. Solid State Chemistry & its Applications, John Wiley & Sons (1987).

[2] West, A.R. Basic Solid State Chemistry, 2nd Edition, John Wiley & Sons (2000).

[3] Smart, L.E. & Moore, E.A. Solid State Chemistry - An Introduction, 3rd Edition, CRC Press (2005).

[4] Rodgers, G.E. Descriptive Inorganic, Coordination & Solid-State Chemistry, 3rd Edition, Brooks/Cole, Cengage learning (2002).

[5] Tilley, R.J.D. Understanding Solids: The science of materials. , 2nd Edition, John Wiley & Sons (2004).

[6] Christian, G. D., Analytical Chemistry, 6th Ed., John Wiley & Sons, Inc. (2004).

[7] Skoog, D. A., West, D. M., Holler, R. J & Nieman, T. A. Principles of Instrumental Analysis Saunders Golden Sunburst Series (1997).

[8] Willard, H. H., Merritt, L. L., Dean, J. A. & Settle, F. A. (Eds.) Instrumental Methods of Analysis - 7th Ed., Wadsworth Publishing (1988) ISBN 0534081428

[9] Cullity, B.D. & Stock, S.R. Powder X-Ray Diffraction, 3rd edition, Kindle Publisher 2001.

[10] Stout, G.H. & Jensen, L. H. X- Ray structure Determination A Practical Guide IIed (John Wiley & Sons), 1989.

Chemistry of Nanomaterial

Title: Chemistry of Nanomaterial **Code: 21M11CH105**

L-T-P Scheme: 2-1-0 **Credit: 3**

Prerequisite: The students must be aware of basic Inorganic, Physical and Organic Chemistry up to the graduate level. This knowledge helps them to correlate and adopt at Master Level (Post Graduate).

Objective:

To educate the dramatic changes in properties that occurs by reducing the size and shape of materials. To impart knowledge on how to perform the synthesis of such small sizes and shapes of materials.

Course Learning Outcomes:

Course Outcome	Description
CO1	The outline, outcomes, and attributes provide students with learning experiences that help in achieving deep interests in learning. Students will learn the basic changes in properties of materials when the size and shape were changed together with their various ways of achieving them
CO2	Describe the real-world problems, challenges with the application of the Nanomaterial Chemistry.
CO3	Develop in students the ability to apply the knowledge and skills they have acquired to the solution of specific theoretical and applied problems in nanomaterials.
CO4	Identify and use various analytical techniques in characterization and application of nanomaterial.
CO5	Apply experimental demonstration and validation by using various analytical techniques given in theorem, principles as explained in lectures.
CO6	Demonstrate students with the knowledge and skill base that would enable them to undertake further studies. It helps to develop a range of generic skills that are relevant to wage employment, self-employment, and entrepreneurship.

COURSE CONTENT

Unit 1:

Properties of Nanomaterials Introduction: Properties of materials & nanomaterials, role of size and shape in nanomaterials. Electronic Properties: Classification of materials: Metal, Semiconductor, Insulator, Band structures, Brillouin zones, Mobility, Resistivity.

Magnetic Properties: Superparamagnetism, blocking. Important properties in relation to nanomagnetism. Optical Properties: Photoconductivity, Optical absorption & transmission, Photoluminescence, Fluorescence, Phosphorescence, Electroluminescence. Thermal Properties and Mechanical Properties;

Unit 2:

Synthesis and Characterization of Nanomaterials-

Chemical Methods: Metal nanocrystals by reduction, Solvothermal synthesis, Photochemical synthesis, Electrochemical synthesis, Nanocrystals of semiconductors and other materials by arrested precipitation, Thermolysis routes, Sonochemical routes, Post-synthetic size-selective processing. Solgel, Micelles and microemulsions.

Biological Methods of Synthesis: Use of bacteria, fungi, Actinomycetes for nanoparticles synthesis, Magnetotactic bacteria for natural synthesis of magnetic nanoparticles; Mechanism of formation; Viruses as components for the formation of nanostructured materials; Synthesis process and application, Role of plants in nanoparticle synthesis.

Unit 3:

Characterization Techniques: X-ray diffraction, Scanning Probe Microscopy, SEM, TEM, Optical microscope and their description, operational principle and application for analysis of nanomaterials, UV-VIS-IR Spectrophotometers. Learning Outcomes: Students will learn the basic changes in properties of materials when the size and shape were changed together with their various ways of achieving them. Characterization of ultra small particles will be learnt.

Teaching Methodology:

This syllabus has been implemented for helping the students to understand Chemistry of nanomaterials. The entire syllabus has divided into three units. Each section includes multiple topics to help a student gain a deeper understanding Chemistry of Nanomaterial. This course is dividing into 28 Lectures and 14 Tutorial. The facility provided in LRC for both textbooks of ebook for getting a better understanding of students. The NPTEL lecture was also made available to students.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1 and Unit-2
Test-2	25 Marks	Based on Unit-2 & Unit-3 (80 %) and around 20% from coverage of Test-1
Test-3	35 Marks	Based on Unit-3 to Unit-4 (80%) and around 20% from coverage of Test-1 and Text-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slide on Web Development (will be added from time to time): Digital copy will be available on the JUET server.

Text Books:

[1] Dupas, C., Houdy, P. & Lahmani, M. Nanoscience: Nanotechnology and Nanophysics, Springer (2004).

[2] Klabunde, K. J., Ed. Nanoscale Materials in Chemistry, Wiley Interscience (2001).

[3] Kulkarni, S. K. Nanotechnology: Principles and Practices, Capitol Publishing Company (2007).

[4] Wilson, M., Kannangara, K., Smith, G., Simmons, M. & Raguse, B. Nanotechnology: Basic Science and Emerging Technologies, Overseas Press (2005).

[5] Poole Jr., C. P. & Ovens, F. J. Introduction to Nanotechnology, Wiley Interscience (2003).

[6] Edelstein, A.S. & Cammarata, R. C., Ed. Nanomaterials: Synthesis, Properties and Applications, Institute of Physics Publishing (1996).

Physical Chemistry Lab

Title: Physical Chemistry Lab **Code: 12M17CH171**

L-T-P Scheme: 0-0-2 **Credit: 1**

Prerequisite: The students must be aware of experiment in the area of Electrochemistry, Kinetics, Surface Chemistry, and Radiation Chemistry up to the graduate level. This knowledge helps them to correlate and adopt at Master Level (Post Graduate).

Objective:

The purpose behind this course is to make the students upgrade the concepts and analyze their application in the commercial and applied level of Physical Chemistry. The objective of this course is to prepare students ready for the future in Energy, Battery, Enzyme, and Chemical Industry.

Course Learning Outcomes:

Course Outcome	Description
CO1	The outline, outcomes, and attributes provide students with learning experiences that help in achieving deep interests in learning Electrochemistry, Kinetics, Surface Chemistry, and Radiation Chemistry. It will develop broad and balanced knowledge and understanding of the concepts of key chemical, principles, and theories related to Physical Chemistry; and equip students with appropriate tools of analysis to tackle issues and problems in the field of Physical chemistry.
CO2	Describe the real-world problems, challenges with the application of the Electrochemistry, Kinetics, Surface Chemistry, and Radiation Chemistry.
CO3	Develop in students the ability to apply the knowledge and skills they have acquired to the solution of specific theoretical and applied problems in Electrochemistry, Kinetics, Surface Chemistry, and Radiation Chemistry.
CO4	Identify and use various analytical techniques in Electrochemistry, Kinetics, Surface Chemistry, and Radiation Chemistry based project management.
CO5	Apply experimental demonstration and validation by using various analytical techniques given in theorem, principles as explained in lectures.

CO6 Demonstrate students with the knowledge and skill base that would enable them to undertake further studies in Electrochemistry, Kinetics, Surface Chemistry, and Radiation Chemistry. It helps to develop a range of generic skills that are relevant to wage employment, self-employment, and entrepreneurship.

List of Experiment

[1] To prepare the standard solution of NaOH by double titration method.

[2] To determine the pH, electrical conductivity and dissolved oxygen of given water samples by using respective electrode.

[3] To determine the viscosity of unknown liquid by using Ostwald Viscometer.

[4] To determine the surface tension of unknown liquid by using Stalgmometer.

[5] Saponification of ethyl acetate with sodium hydroxide by chemical method.

[6] Comparison of acid strengths through acid catalyzed methyl acetate hydrolysis.

[7] Energy of activation of acid catalyzed hydrolysis of methyl acetate.

[8] To determine the total hardness, permanent hardness and temporary hardness of given water samples

[9] To determine alkalinity and acidity of given water samples.

[10] To determine the equivalence point in strong acid vs. strong base, by conductometric titration methods.

11. Molecular weight of a non-electrolyte by cryoscopy method.

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Teaching Methodology:

This course planned in 11 lab experiment and each experiment having 2 hours practical exposure in Chemistry lab. Their continuous evaluation will be performed in each week and weightage

given during finalizing of the grade sheet. At the end of this course student will be able to: Understand the applications of the Physical Chemistry in various field.

Evaluation Scheme:

Exams		Marks	Coverage
P-1		15 Marks	Based on Lab Exercises: 1-6
P-2		15 Marks	Based on Lab Exercises: 7-11
Day-to-Day Work	Viva	20 Marks	70 Marks
	Demonstration	20 Marks	
	Lab Record	15 Marks	
	Attendance & Discipline	15 Marks	
Total		100 Marks	

Learning Resources:

Study material of Web Technology Lab (will be added time to time): Digital copy will be available on the JUET server.

Text Book

1. Practical Chemistry Labs, by Leonard Saland**, Manufacturer:** Walch Education 015116

Reference Book

1. Green Chemistry, by Sally A. Henrie, CRC Press Published March 18, 2015.
2. Drinking Water Chemistry: A Laboratory Manual by Barbara Hauser, CRC Press Published August 21, 2001.

Organic Chemistry Lab

Title: Organic Chemistry Lab **Code: 12M17CH172**

L-T-P Scheme: 0-0-2 **Credit: 1**

Prerequisite: The students must be aware of Organic Chemistry up to the graduate level. This knowledge will help to achieve excellence in the identification and characterization of organic compounds as well as excel in heterocyclic organic compounds.

Objective:

This course will help the students to upgrade their concepts of structure and reactivity of aromatic compounds. It also helps in learning of Stereochemistry and Stereoisomerism of hexacyclic & cyclic organic compounds. It also elucidates the heterocyclic compounds, synthesis, and their characterization.

Course Learning Outcomes:

Course Outcome	Description
CO1	The outline, outcomes, and attributes provide students with learning experiences in Organic Chemistry. It develops broad and balanced knowledge and understanding of synthesis and characterizations. Further, it equips students with appropriate tools of analysis to tackle issues and problems in the field of Organic Chemistry.
CO2	Describe the real-world problems and challenges through applications of the aromatic, non-aromatic, and heterocyclic organic compounds.
CO3	Develop in students the ability to apply the knowledge and skills they have acquired to the solution of specific theoretical and applied problems in synthesis and characterization of the organic compound.
CO4	Identify and use various analytical techniques in synthesis and characterization of the organic compound to effectively uses in Project Management.
CO5	Apply experimental demonstration and validation by using various analytical techniques given in theorem, principles as explained in Lab.

CO6 Demonstrate students with the knowledge and skill base that would enable them to undertake further studies in synthesis and characterization of the organic compound. It helps to develop a range of generic skills that are relevant to wage employment, self-employment, and entrepreneurship.

List of experiments

[1] Element detection and functional groups testing.

[2] Separation of mixture

i) Liquid mixtures: e.g. Ether + Arene

ii) Solid mixture: e.g. Arene + acid and Arene + carbohydrates

[3] Preparation of derivatives

i) Oxime derivatives

ii) 2-4 DNP (2-4 di nitro phenyl hydazone)

[4] Single stage preparation of organic compound

i) Benzamide

ii) Hexamethylene tetra amine(urotropine)

iii) Dimethyl phthalate

iv) Methyl salicylate

v) Phthalimide

[5] Use of computer –Chem draw-sketch, ISI-draw

i) Draw structure of simple aliphatic, aromatic, heterocyclic organic compound.

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Teaching Methodology:

This course planned in 5 lab experiment and each experiment having 2 hours practical exposure in Chemistry lab. Their continuous evaluation will be performed in each week and weightage given during finalizing of the grade sheet. At the end of this course student will be able to: Understand the applications of the Organic Chemistry in various field.

Evaluation Scheme:

Exams		Marks	Coverage
P-1		15 Marks	Based on Lab Exercises: 1-3
P-2		15 Marks	Based on Lab Exercises: 4-5
Day-to-Day Work	Viva	20 Marks	70 Marks
	Demonstration	20 Marks	
	Lab Record	15 Marks	
	Attendance & Discipline	15 Marks	
Total		100 Marks	

Learning Resources:

Study material of Web Technology Lab (will be added time to time): Digital copy will be available on the JUET server.

Text Book

2. Organic Chemistry Lab Technique, Lisa Nichols Publisher, by Lisa Nichols, Butte Community College.

3. Reference Book

3. Green Chemistry, by Sally A. Henrie, CRC Press Published March 18, 2015.
4. Drinking Water Chemistry: A Laboratory Manual by Barbara Hauser, CRC Press Published August 21, 2001.

Recommended Book

1. “Advanced practical organic chemistry” second revised edition, by N.K. Vishnoi, published by Vikas Publishing House Pvt.Limited, New Delhi

Inorganic Chemistry Lab

Title: Inorganic Chemistry Lab **Code: 12M17CH173**

L-T-P Scheme: 0-0-2 **Credit: 1**

Prerequisite: The students must be aware of Transition and Inner-Transition metal Chemistry up to graduate level. This knowledge helps them to learn in-depth synthesis and characterization of Transition and Inner-Transition metal complex compounds.

Objective:

The purpose behind this course is to make the students upgrade the concepts and analyze their application in the commercial and applied level (Inorganic compound). The objective of this course is to prepare students ready for the future in Energy, Nanomaterial, Enzyme, and Chemical industries.

Course Learning Outcomes:

Course Outcome	Description
CO1	The outline, outcomes, and attributes provide students with learning experiences that help instill deep interests in learning. It develops broad and balanced knowledge and understanding of key-chemical concepts, principles, and theories related to transition and inner-transition metal; and equip students with appropriate tools of analysis to tackle issues and problems in the field of Inorganic Chemistry.
CO2	Describe the real-world problems, challenges with the application of the metal-ligand bonding, biological molecules containing transition, and inner-transition metals.
CO3	Develop in students the ability to apply the knowledge and skills they have acquired to the solution of specific theoretical and applied problems in Energy, Nanomaterial, Enzyme, and Chemical industries.
CO4	Identify and use various analytical techniques in Energy, Nanomaterial, Enzyme, and Chemical Industry.
CO5	Apply experimental demonstration and validation by using various analytical techniques given in theorem, principles as explained in lectures.
CO6	Demonstrate students with the knowledge and skill base that would enable them to undertake further studies in Inorganic Chemistry helps to develop a range of generic

skills that are relevant to wage employment, self-employment, and entrepreneurship.

List of experiments:

[1] Quantitative separation and determination of the following pairs of metal ions using gravimetric and volumetric methods:

(i) Ag^{+} (gravimetrically) and Cu^{2+} (Volumetrically)

(ii) Cu^{2+} (gravimetrically) and Zn^{2+} (Volumetrically)

(iii) Fe^{3+} (gravimetrically) and Ca^{2+} (Volumetrically)

(iv) Mg^{2+} (gravimetrically) and Ca^{2+} (Volumetrically)

[2] Separation of a mixture of cations/anions by a paper chromatographic technique using aqueous/ nonaqueous media.

(i) Pb^{2+} and Ag^{+} (aqueous and non-aqueous media)

(ii) Co^{2+} and Cu^{2+} (non-aqueous medium)

(iii) Cl^{-} and I^{-} (aqueous-acetone medium)

(iv) Br^{-} and I^{-} (aqueous-acetone medium)

Evaluation Scheme:

Exams		Marks	Coverage
P-1		15 Marks	Based on Lab Exercises: 1
P-2		15 Marks	Based on Lab Exercises: 2
Day-to-Day Work	Viva	20 Marks	70 Marks
	Demonstration	20 Marks	
	Lab Record	15 Marks	
	Attendance & Discipline	15 Marks	
Total		100 Marks	

Learning Resources:

Study material of Web Technology Lab (will be added time to time): Digital copy will be available on the JUET server.

Text Book

1. Inorganic Chemistry Lab Technique, Lisa Nichols Publisher, by Lisa Nichols, Butte Community College.

(v) Reference Book

2. Green Chemistry, by Sally A. Henrie, CRC Press Published March 18, 2015.
3. Drinking Water Chemistry: A Laboratory Manual by Barbara Hauser, CRC Press Published August 21, 2001.

Semester II

Quantum Chemistry

Title: Quantum Chemistry **Code: 12M11CH201**

L-T-P Scheme: 3-1-0 **Credit: 4**

Prerequisite: The students must be aware of Quantum Chemistry up to graduate level. This knowledge helps them to learn in-depth understanding of complex Quantum Chemistry and their application.

Objective:

The purpose behind this course is to make the students upgrade the concepts and analyze their application in the commercial and applied level. The objective of this course is to prepare students ready for the future application of Quantum Mechanics and Quantum Chemistry.

Course Learning Outcomes:

Course Outcome	Description
CO1	The outline, outcomes, and attributes provide students with learning experiences that help instill deep interests in learning. It develops broad and balanced knowledge and understanding of key-fundamentals of quantum chemistry, approximation method, group thoery; and equip students with appropriate tools of analysis to tackle issues and problems in the field of Quantum Chemistry.
CO2	Describe the real-world problems, challenges with the application of the approximation method, group theory in Quantum Chemistry.
CO3	Develop in students the ability to apply the knowledge and skills they have acquired to the solution of specific theoretical and applied problems in Quantum Chemistry.
CO4	Identify and use various analytical techniques in area of Quantum Chemistry.
CO5	Apply experimental demonstration and validation by using various numerical methods given in theorem, principles as explained in lectures.
CO6	Demonstrate students with the knowledge and skill base that would enable them to undertake further studies in Quantum Chemistry helps to develop a range of generic skills that are relevant to wage employment, self-employment, and entrepreneurship.

Teaching Methodology:

This syllabus has been implemented for helping the students to understand structure Electrochemistry, Kinetics, Surface Chemistry, and Radiation Chemistry. The entire syllabus has divided into four units. Each section includes multiple topics to help a student gain a deeper understanding of Physical Chemistry. This course is divide into 42 Lectures, 14 Tutorial, and 14 Experiments. The facility provided in LRC for both textbooks of ebook for getting a better understanding of students. The NPTEL lecture was also made available to students.

Course Content

Unit 1: Fundamentals: Review of Classical Mechanics. General formulation of Qunatum Mechanics. Review of angular momentum, rigid rotor, harmonic oscillator and H- atom problems.

Unit 2: Approximation Methods: Stationary perturbation theory for non-degenerate and degenerate systems with examples. Variation method. Ground state of He atom. Time-dependent perturbation theory. Radioactive transitions. Einstein coefficients. Many Electron atoms: Hartree SCF method, Electron correlation, Addition of angular momenta– Clabsch-Gordan series, Term symbols for two equivalent electrons, Total angular momentum and spinor bit interaction. Condon Slater Rules.

Unit 3: Group Theory: Review and Applications. Ab initio Methods for Closed Shell Systems: Review of molecular structure calculations, dipole moments. Hartree-Fock method for molecules. Roothaan-Hartree-Fock method. Selection of basis sets. Density functional Method. Population
analysis.

Books Recommended

1. P.W. Atkins and R.S. Friedman, Molecular Quantum Mechanics, 3rd edition (1997), Oxford University Press.Oxford.
2. H. Eyring, J. Walter and G.E. Kimball, Quantum Chemistry, John Wiley, New York (1944)
3. I.N. Levine, Quantum Chemistry, 5th edition (2000), Pearson Educ., Inc., New Delhi.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1 and Unit-2
Test-2	25 Marks	Based on Unit-2 & Unit-3 (80 %) and around 20% from coverage of Test-1
Test-3	35 Marks	Based on Unit-3 to Unit-4 (80%) and around 20% from coverage of Test-1 and Text-2
Assignment	10 Marks	
Tutorials	5 Marks	

Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slide on Web Development (will be added from time to time): Digital copy will be available on the JUET server.

INDUSTRIAL ORGANIC SYNTHESIS

Title: Industrial Organic Synthesis **Code: 12M11CH202**

L-T-P Scheme: 3-1-0 **Credit: 4**

Prerequisite: The students must be aware of Organic Chemistry up to graduate level. This knowledge helps them to learn in-depth understanding mechanism of industrial synthesis and their application.

Objective:

The purpose behind this course is to make the students upgrade the concepts and analyze their application in the commercial and applied level. The objective of this course is to prepare students ready for the future application of technology in industrial synthesis..

Course Learning Outcomes:

Course Outcome	Description
CO1	The outline, outcomes, and attributes provide students with learning experiences that help instill deep interests in learning. It develops broad and balanced knowledge and understanding of key-chemical concepts, principles, and theories related to industrial synthesis.
CO2	Describe the real-world problems, challenges with the application of the carbohydrate, terpene, and alkaloid in the various zone of pharmaceutical industry.
CO3	Develop in students the ability to apply the knowledge and skills they have acquired to the solution of specific theoretical and applied problems in industrial synthesis.
CO4	Identify and use various analytical techniques in Industrial synthesis of organic compound.
CO5	Apply experimental demonstration and validation by using various analytical techniques given in theorem, principles as explained in lectures.
CO6	Demonstrate students with the knowledge and skill base that would enable them to undertake further studies in Industrial Organic Synthesis helps to develop a range of generic skills that are relevant to wage employment, self-employment, and entrepreneurship.

Teaching Methodology:

This syllabus has been implemented for helping the students to understand structure Electrochemistry, Kinetics, Surface Chemistry, and Radiation Chemistry. The entire syllabus has divided into four units. Each section includes multiple topics to help a student gain a deeper understanding of Physical Chemistry. This course is divide into 42 Lectures, 14 Tutorial, and 14 Experiments. The facility provided in LRC for both textbooks of ebook for getting a better understanding of students. The NPTEL lecture was also made available to students.

Course Content

Unit-1 PROCESS INVOLVED DURING ORGANIC SYNTHSIS

Nitration

Introduction, nitrating agent, process equipment for technical nitration

Halogenation

Introduction, chlorination in the presence of catalyst, technical halogenation.

Sulphonation

Introduction, industrial equipment and techniques.

Unit-2 SYNTHESIS OF NATURAL PRODUCTS

Introduction to the Chemistry of Natural Products and their synthesis and important chemical reactions;

Carbohydrate

Introduction, classification of carbohydrate; production of sugar .Preparation of Glucose, fructose, starch and cellulose and industrially useful reactions, structure of sucrose.

Terpenes,

Introduction and classification of terpenes; Mono terpenes e.g. citral, camphor; Preparation of camphor, detailed study of Lycopene, squalene, B-carotene, lanosterol, vitamin-A, rubber rand gutta –parcha

Alkaloids,

Introduction of alkaloids, old structure based classification, detailed study of conine, cocaine, caffeine and nicotine.

Steroids

Introduction and classification of steroids, Chemical structure and properties of Cholesterol, Ergosterol,vitamin-D, stigmasterol. Bile acids, Hormones; Andosterons, oestrogenes and gestogenes**.**

Unit-3 Pigments, and their synthesis

Unit-4 Synthesis for industrially important polymers:

Polyethylene, polystyrene, PVC, polyisobutylene, polyester, nylon, bakelite, Teflon

Unit-5 Synthesis of Important materials for Industry
Ceramics, Glasses, Zeolites.

TEXT BOOKS

1. O.P. Agarawal 'Chemistry of Organic Natural Products Vol-1"
2. O.P. Agarawal 'Chemistry of Organic Natural Products Vol-2"
3. P. H. Griggins "Unit processes in organic synthesis".

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1 and Unit-2
Test-2	25 Marks	Based on Unit-2 & Unit-3 (80 %) and around 20% from coverage of Test-1
Test-3	35 Marks	Based on Unit-3 to Unit-4 (80%) and around 20% from coverage of Test-1 and Text-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slide on Web Development (will be added from time to time): Digital copy will be available on the JUET server.

Chemical Dynamics & Surface Chemistry

Title: Chemical Dynamics & Surface Chemistry **Code: 12M11CH203**

L-T-P Scheme: 3-0-0 **Credit: 3**

Prerequisite: The students must be aware of Electrochemistry, Kinetics, Surface Chemistry, and Radiation Chemistry up to the graduate level. This knowledge helps them to correlate and adopt at Master Level (Post Graduate).

Objective:

The purpose behind this course is to make the students upgrade the concepts and analyze their application in the commercial and applied level of Chemistry. The objective of this course is to prepare students ready for the future in Energy, Battery, Enzyme, and Chemical Industry.

Course Learning Outcomes:

Course Outcome	Description
CO1	The outline, outcomes, and attributes provide students with learning experiences that help in achieving deep interests in learning Electrochemistry, Kinetics, Surface Chemistry, and Radiation Chemistry. It will develop broad and balanced knowledge and understanding of the concepts of key chemical, principles, and theories related to Physical Chemistry; and equip students with appropriate tools of analysis to tackle issues and problems in the field of Physical chemistry.
CO2	Describe the real-world problems, challenges with the application of the Electrochemistry, Kinetics, Surface Chemistry, and Radiation Chemistry.
CO3	Develop in students the ability to apply the knowledge and skills they have acquired to the solution of specific theoretical and applied problems in Electrochemistry, Kinetics, Surface Chemistry, and Radiation Chemistry.
CO4	Identify and use various analytical techniques in Electrochemistry, Kinetics, Surface Chemistry, and Radiation Chemistry based project management.
CO5	Apply experimental demonstration and validation by using various analytical techniques given in theorem, principles as explained in lectures.
CO6	Demonstrate students with the knowledge and skill base that would enable them to

undertake further studies in Electrochemistry, Kinetics, Surface Chemistry, and Radiation Chemistry. It helps to develop a range of generic skills that are relevant to wage employment, self-employment, and entrepreneurship.

Teaching Methodology:

This syllabus has been implemented for helping the students to understand structure Electrochemistry, Kinetics, Surface Chemistry, and Radiation Chemistry. The entire syllabus has divided into four units. Each section includes multiple topics to help a student gain a deeper understanding of Physical Chemistry. This course is divide into 42 Lectures, 14 Tutorial, and 14 Experiments. The facility provided in LRC for both textbooks of ebook for getting a better understanding of students. The NPTEL lecture was also made available to students.

Course Content

Unit : 1

Activity Coefficient and Ionic Migration in Electrolyte Solutions: Quantitative treatment of Debye-Hückel theory of ion-ion interaction and activity coefficient, applicability and limitations of Debye-Hückel limiting law, its modification for finite-sized ions, effect of ion-solvent interaction on activitycoefficient. Debye-Hückel-Onsagar (D-H-O) theory of conductance of electrolyte solution, its applicability and limitations, Pair-wise association of ions (Bjerrum and Fuoss treatment), Modification of D-H-O theory to account for ion-pair formation, Determination of association constant (KA) from conductance data.

Unit: 2

Electrical Double Layer at Metal/Electrolyte Interface: Thermodynamics of double layer, Electrocapillary equation, Determination of surface excess and other electrical parameters electro capillarity, excess charge capacitance, and relative surface excesses. Metal/ water interaction-Contact adsorption, its influence on capacity of interface, complete capacity- potential curve, Constant capacity region hump. Specific adsorption-extent of specific adsorption.

Unit: 3

Electrode Kinetics: Review of Butler-Volmer treatment. Polarizable and non-polarizable interfaces. Multistep reactions- a near equilibrium relation between current density and over potential, Concept of rate determining step. Determination of reaction order. Stochiometric number, and transfer coefficient. Electrocatalysis-comparison of electrocatalytic activity. Importance of oxygen reduction and hydrogen evolution reactions and their mechanisms.

Unit: 4

Electrochemical Techniques: Impedance technique-its application for studying electrode kinetics and corrosion. Rotating Disc Electrode (RDE): Application of for measurement of electrochemical rate constant.

Unit: 5

Surface Chemistry and Catalysis: Bimolecular surface reactions - reaction between a gas molecule and an adsorbed molecule, reaction between two adsorbed molecules, inhibition and activation energy of such reactions. Catalytic activity at surfaces (volcano curve), transition state theory of surface reactions: rates of chemisorption and desorption, unimolecular and bimolecular surface reaction, comparison of homogeneous and heterogeneous reaction rates, surface heterogeneity, lateral interaction

Books Recommended

1. *Modern Electrochemistry*, Vol. 1 & 2A and 2 B, J.O'M. Bockris and A.K.N. Reddy,Plenum Press, New York (1998).
2. *Electrochemical Methods: Fundamentals and Applications*; A.J. Bard and L.R. Faulkner, 2nd edition (2001), John Wiley & Sons, New York.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1 and Unit-2
Test-2	25 Marks	Based on Unit-2 & Unit-3 (80 %) and around 20% from coverage of Test-1
Test-3	35 Marks	Based on Unit-3 to Unit-4 (80%) and around 20% from coverage of Test-1 and Text-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slide on Web Development (will be added from time to time): Digital copy will be available on the JUET server.

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Physical Methods of Structure Determination

Title: Physical Methods of Structure Determination **Code: 12M11CH204**

L-T-P Scheme: 3-1-0 **Credit: 4**

Prerequisite: The students must be aware of basic Analytical Technique at graduate level. This knowledge helps them to correlate and adopt at Master Level (Post Graduate).

Objective:

The purpose behind this course is to make the students upgrade the concepts and knowledge about various Analytical Technique used in characterization of organic and inorganic compounds. The objective of this course is to prepare students ready for the future in Chemical Industry and Research Activity.

Course Learning Outcomes:

Course Outcome	Description
CO1	The outline, outcomes, and attributes provide students with learning experiences that help in achieving deep interests in learning physical methods of structure determination. It will develop broad and balanced knowledge and understanding of the concepts of key technology and equip students with appropriate tools of analysis to tackle issues and problems in the field of Chemistry.
CO2	Describe the real-world problems, challenges with the application of the spectroscopy and other special methods in area of Chemistry.
CO3	Develop in students the ability to apply the knowledge and skills they have acquired to the solution of specific theoretical and applied problems in Chemistry.
CO4	Identify and use various analytical techniques based project management.
CO5	Apply experimental demonstration and validation by using various analytical techniques given in theorem, principles as explained in lectures.
CO6	Demonstrate students with the knowledge and skill base that would enable them to undertake further studies in the Spectroscopy. It helps to develop a range of generic skills that are relevant to wage employment, self-employment, and entrepreneurship.

Teaching Methodology:

This syllabus has been implemented for helping the students to understand structure Electrochemistry, Kinetics, Surface Chemistry, and Radiation Chemistry. The entire syllabus has

divided into four units. Each section includes multiple topics to help a student gain a deeper understanding of Physical Chemistry. This course is divide into 42 Lectures, 14 Tutorial, and 14 Experiments. The facility provided in LRC for both textbooks of ebook for getting a better understanding of students. The NPTEL lecture was also made available to students.

Course Content

Unit: 1

Crystallography: Braggs Law, X-ray crystallography, XRF.

Unit: 2

Spectroscopy: Bear's Lamberts Law, Transmittance, absorbance, Nuclear Magnetic Resonance or NMR technique. IR, UV Visible spectroscopy, multiple isomorphous replacement, isotropic, anisotropic,

Unit: 3

Special Technique: Fourier transformation, Finger Printing, atomization, Atomic absorption spectrophotometer (AAS)

Unit: 4

Special method: Voltametry, Amperometric, conductometric, Potentiometric titration etc. Equivalence point, End point.

Books Recommended

1. Elementary Organic Spectroscopy; Principles and Chemical Applications- YR Sharma
2. Fundamental Molecular spectroscopy, By CN Banwell

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1 and Unit-2
Test-2	25 Marks	Based on Unit-2 & Unit-3 (80 %) and around 20% from coverage of Test-1
Test-3	35 Marks	Based on Unit-3 to Unit-4 (80%) and around 20% from coverage of Test-1 and Text-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slide on Web Development (will be added from time to time): Digital copy will be available on the JUET server.

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Organic Chemistry-2

Title: Organic Chemistry **Code: 12M11CH205**

L-T-P Scheme: 3-0-0 **Credit: 3**

Prerequisite: The students must be aware of Organic Chemistry up to the graduate level. This knowledge will help to achieve excellence in the identification and characterization of organic compounds as well as excel in Organic Compounds Synthesis.

Objective:

This course will help the students to upgrade their concepts of structure and reactivity of aromatic compounds. It also helps in learning of Name Reaction and UV/Vis, NMR, Mass Spectroscopy. It also elucidates the synthesis of organic compound, and their characterization.

Course Learning Outcomes:

Course Outcome	Description
CO1	The outline, outcomes, and attributes provide students with learning experiences in Organic Chemistry. It develops broad and balanced knowledge and understanding of synthesis and characterizations. Further, it equips students with appropriate tools of analysis to tackle issues and problems in the field of Organic Chemistry.
CO2	Describe the real-world problems and challenges through applications of the name reaction and various techniques in characterization of organic compounds.
CO3	Develop in students the ability to apply the knowledge and skills they have acquired to the solution of specific theoretical and applied problems in synthesis and characterization of the organic compound.
CO4	Identify and use various analytical techniques in synthesis and characterization of the organic compound to effectively use in Project Management.
CO5	Apply experimental demonstration and validation by using various analytical techniques given in theorem, principles as explained in lectures.
CO6	Demonstrate students with the knowledge and skill base that would enable them to undertake further studies in synthesis and characterization of the organic

compound. It helps to develop a range of generic skills that are relevant to wage employment, self-employment, and entrepreneurship.

Teaching Methodology:

This syllabus has been implemented for helping the students to understand structure Electrochemistry, Kinetics, Surface Chemistry, and Radiation Chemistry. The entire syllabus has divided into four units. Each section includes multiple topics to help a student gain a deeper understanding of Physical Chemistry. This course is divide into 42 Lectures, 14 Tutorial, and 14 Experiments. The facility provided in LRC for both textbooks of ebook for getting a better understanding of students. The NPTEL lecture was also made available to students.

Course Content:

UNIT - I

Aromatic substitution reactions - electrophilic, nucleophilic and through benzynes – radical substitution of arenes - orientation of nucleophilic substitution at a saturatéd, carbon, SN_1, SN_2, SNi reactions -effect of structure, nucleophile, leaving group, solvent. Additions involving electrophiles, nucleophiles and free radicals. Elimination reactions - El, - E1CB, E2 reactions – elimination versus substitution reactions.

UNIT – II

Mechanism of some name reactions: Aldol, Perkin, Benzoin, Cannizaro, Wittig, Grignard, Reformatsky - Meerwein, Hoffmann Claisen and Favorsky rearrangements. Hydroboration - openauer oxidation, clemmensen reduction - Meerwein - Pondorf and verley and Birch reductions. Stork enamine reactions, Michael addition, Mannich Reaction, Diels - Alder reaction, Ene - reaction, Bayer - Villiger Reaction.

UNIT - III

Spectra and structure - application of organic spectroscopy UV, IR, ^{1}HNMR and Mass spectral data.

UNIT - IV

Isolation, structure elucidation and synthesis of alkaloids; atropine, nicotine, and quinine. Purines - Caffeine configuration and ring structures of glucose and fructose, anomeric effects.

Text books:

1. Organic Chemistry Vol. I (Sixth Edn.) and Vol. II (Fifth Ed.,) by IL finar ELBS.
2. Organic Chemistry (fifth Edn.,) by Morrison and Boyd, PHI, India.
3. Organic Chemistry (fifth edition)by Francis A. Carey Tata Mc Graw Hill publishing company Limited, New Delhi.
4. Reaction Mechanism in Organic Chemistry by Mukherjee Sirigh, NTerniitarr, Indiar
5. A guide book to mechanism in Organic Chemistry by Peter Sykes, ELBS.

REFERENCE BOOKS:

1. Advanced organic chemistry by Jerry March (4th Edition)Wiley Eastern. .
2. Chemistry of Natural Products, K.W.Bentley by stereochemistry of carbon compounds by E.Eliel, John Wiley & Sons, Inc.
3. Stereochemistry of Organic compounds by D. Nasipuri.
4. Chemistry of Natural products by R.S. Kalsi Kalyani Publishers. 1983.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1 and Unit-2
Test-2	25 Marks	Based on Unit-2 & Unit-3 (80 %) and around 20% from coverage of Test-1
Test-3	35 Marks	Based on Unit-3 to Unit-4 (80%) and around 20% from coverage of Test-1 and Text-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slide on Web Development (will be added from time to time): Digital copy will be available on the JUET server.

Polymer Engineering

Title: Polymer Engineering **Code: 21M11CH206**

L-T-P Scheme: 2-1-0 **Credit: 3**

Perquisites:

The students should complete the Chemistry course at under graduate level before considering this course for the study.

Course objectives: This course will be enable students to identify the various mechanisms for the synthesis and characterization of Polymer. This course enables students to understand the mechanism of Polymer Engineering and develop an ability to learn for enhancing the quality of polymer through various additives.

Course Outcome	Description
CO1	The outline, outcomes and attributes provide students with learning experiences that help in still deep interests in learning of Polymer Engineering. It develops broad and balanced knowledge and understanding of the Polymer Engineering concepts, principles, and theories.
CO2	Describe the real world problems, challenges in current scenario.
CO3	Develop in students the ability to apply the knowledge and skills they have acquired to the solution of specific theoretical and applied problems of the world.
CO4	Identify and use of various techniques for resolving the world problem and in project management.
CO5	Apply experimental demonstration and validation by using various techniques given in theorem, principles as explained in lectures.
CO6	Demonstrate students with the knowledge and skill base that would enable them to undertake further studies in the Polymer Engineering and related areas or in multidisciplinary areas that help develop a range of generic skills that are relevant to wage employment, self-employment and entrepreneurship.

COURSE CONTENT:

Unit1 :

Introduction: Defining polymers; Basic chemistry of polymers; Classification and types; Bonding in polymers, Molecular weight and Molecular Weight Distribution; Thermoplastic Thermosetting polymers, Elastomers, Resins, Adhesives, Coatings, Fiber, Composites; solvents, Solutions, Blend Melt; Additives, Fillers; Examples of industrial and high-performance polymers.

Unit 2:

Step-Growth (Condensation) Polymerization: Features; Definition of functionality; Functionality principle; Derivation of Carothers's Equation; Effect of Stoichemetric imbalance on molecular weight; Mechanism; Kinetics**.**

Unit 3:

Free-Radical Addition (Chain-Growth) Polymerization: Mechanism; Kinetics of homogeneous polymerization; Experimental determination of rate of polymerization; Instantaneous average chain lengths; Temperature dependence of rate and chain length; Gel effect or Auto acceleration; Kinetic chain length; Chain Transfer; Inhibitors and Retarders.

Unit 4:

Ionic and Coordination Chain Polymerization: General Features of ionic-chain addition polymerization; Mechanism and kinetics of cationic polymerization: Mechanism and average degree of polymerization; Kinetics of anionic polymerization; Mechanism and kinetics of coordination Polymerization.

Unit 5:

Co-Polymerization: Basic concept~ Technical significance~ Steady-state assumptions in free-radical Copolymerization. The co-polymer equation ~ Instantaneous molar composition of copolymer formed; Monomer reactivity ratios; Significance and method of Determination~ Types of copolymers; Variation of composition with conversion; Average copolymer composition; Cumulative composition of copolymer~ Mechanisms; Kinetics~ Block and graft copolymers.

Unit 6:

Characterization of Molecular Weight: Types of average molecular weight; Molecular weight and degree of polymerization; Poly-dispersity and Molecular Weight Distribution in Polymers~ Common techniques for measurement of average molecular weights; Viscometry, End-group analysis, Gel permeation chromatography.

Teaching Methodology:

This course planned in 3 lectures each week. The course content divided in two 42 lectures. The lectures will be conducted in both manner white board and Power Point presentation. At the end of this course student will be able to understand the concept of Polymer Engineering and able to apply in further study and research.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit 1, Unit 2 and Unit 3
Test-2	25 Marks	Based on Unit 4, Unit 5 and Unit 6 (70 %) and around 30% from coverage of Test-1
Test-3	35 Marks	Based on Unit 7, Unit 8 and Unit 9 and around 30% from coverage of Test-1 and Text-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slides on Web Development (will be added from time to time): Digital copy will be available on the JUET server.

Text Books:

[1] Gowarikar, V.R. et. al "Polymer Science" , Wiley Eastern, 1984.

[2] Rodriguez, F., "Principles of Polymer Systems." 2 / e, Hemisphere (McGraw Hill), 1982

[3] Ghosh, P, "Polymer Science & Technology of Plastics & Rubbers." Tata McGraw Hill, 1990.

[4] Crawford R.J. "Plastic Engineering," Paragaman (Maxwell Machmillan International), 1987.

Reference Books:

[1] Encyclopedia of Polymer Science & Engineering , Wiley, 1988.

[2] Rosen, S.L. Fundamental Principles of Polymer Engineering, 2nd ed. John Wiley & Sons, Inc., 1993.

[3] McCrum, N.G. et. al. Principles of Polymer Engineering, 2nd ed. , Oxford Sciences; 1997.

[4] Rodrigues, F. Principles of Polymer Systems, McGraw-Hill Book Co., 1970

[5] Bhatnagar, M.S., A Textbook of Polymers, Vol. 1, S. Chand & Co. Ltd., New Delhi, 2004.

[6] Bhatnagar, M.S. A Textbook of Polymers, Vol. II, S. Chand & Co. Ltd. , New Delhi, 2004.

Organic Chemistry Lab-2

Title: Organic Chemistry Lab-2 **Code: 12M17CH271L-**

T-P Scheme: 0-0-2 **Credit: 1**

Prerequisite: The students must be aware of Organic Chemistry up to the graduate level. This knowledge will help to achieve excellence in the identification and characterization of organic compounds as well as excel in heterocyclic organic compounds.

Objective:

This course will help the students to upgrade their concepts of structure and reactivity of aromatic compounds. It also helps in learning of Stereochemistry and Stereoisomerism of hexacyclic & cyclic organic compounds. It also elucidates the heterocyclic compounds, synthesis, and their characterization.

Course Learning Outcomes:

Course Outcome	Description
CO1	The outline, outcomes, and attributes provide students with learning experiences in Organic Chemistry. It develops broad and balanced knowledge and understanding of synthesis and characterizations. Further, it equips students with appropriate tools of analysis to tackle issues and problems in the field of Organic Chemistry.
CO2	Describe the real-world problems and challenges through applications of the aromatic, non-aromatic, and heterocyclic organic compounds.
CO3	Develop in students the ability to apply the knowledge and skills they have acquired to the solution of specific theoretical and applied problems in synthesis and characterization of the organic compound.
CO4	Identify and use various analytical techniques in synthesis and characterization of the organic compound to effectively uses in Project Management.
CO5	Apply experimental demonstration and validation by using various analytical techniques given in theorem, principles as explained in Lab.

CO6 Demonstrate students with the knowledge and skill base that would enable them to undertake further studies in synthesis and characterization of the organic compound. It helps to develop a range of generic skills that are relevant to wage employment, self-employment, and entrepreneurship.

List of experiments

1. Preparation and characterization of two and three steps organic compounds. (five each)

2. Isolation of caffeine from tea leaves.

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Teaching Methodology:

This course planned in 11 lab experiment and each experiment having 2 hours practical exposure in Chemistry lab. Their continuous evaluation will be performed in each week and weightage given during finalizing of the grade sheet. At the end of this course student will be able to: Understand the applications of the Organic Chemistry in various field.

Evaluation Scheme:

Exams		Marks	Coverage
P-1		15 Marks	Based on Lab Exercises: 1-3
P-2		15 Marks	Based on Lab Exercises: 4-5
Day-to-Day Work	Viva	20 Marks	70 Marks
	Demonstration	20 Marks	
	Lab Record	15 Marks	
	Attendance & Discipline	15 Marks	
Total		100 Marks	

Learning Resources:

Study material of Web Technology Lab (will be added time to time): Digital copy will be available on the JUET server.

Text Book

4. Organic Chemistry Lab Technique, Lisa Nichols Publisher, by Lisa Nichols, Butte Community College.

5. Reference Book

5. Green Chemistry, by Sally A. Henrie, CRC Press Published March 18, 2015.
6. Drinking Water Chemistry: A Laboratory Manual by Barbara Hauser, CRC Press Published August 21, 2001.

Recommended Book

4. "Advanced practical organic chemistry" second revised edition, by N.K. Vishnoi, published by Vikas Publishing House Pvt.Limited, New Delhi

Surface Chemistry Lab

Title: Surface Chemistry Lab **Code: 12M17CH272**

L-T-P Scheme: 0-0-2 **Credit: 1**

Prerequisite: The students must be aware of experiment in the area of Chemical Kinetics, and Surface Chemistry up to the graduate level. This knowledge helps them to correlate and adopt at Master Level (Post Graduate).

Objective:

The purpose behind this course is to make the students upgrade the concepts and analyze their application in the commercial and applied level of Chemistry. The objective of this course is to prepare students ready for the future in Energy, Battery, Enzyme, and Chemical Industry.

Course Learning Outcomes:

Course Outcome	Description
CO1	The outline, outcomes, and attributes provide students with learning experiences that help in achieving deep interests in learning Chemical Kinetics, Surface Chemistry, and Radiation Chemistry. It will develop broad and balanced knowledge and understanding of the concepts of key chemical, principles, and theories related to Chemistry; and equip students with appropriate tools of analysis to tackle issues and problems in the field of Physical chemistry.
CO2	Describe the real-world problems, challenges with the application of the Chemical Kinetics, Surface Chemistry, and Radiation Chemistry.
CO3	Develop in students the ability to apply the knowledge and skills they have acquired to the solution of specific theoretical and applied problems in Chemical Kinetics, Surface Chemistry, and Radiation Chemistry.
CO4	Identify and use various analytical techniques in Kinetics, Surface Chemistry, and Radiation Chemistry based project management.
CO5	Apply experimental demonstration and validation by using various analytical techniques given in theorem, principles as explained in lectures.

CO6 Demonstrate students with the knowledge and skill base that would enable them to undertake further studies in Kinetics, Surface Chemistry, and Radiation Chemistry. It helps to develop a range of generic skills that are relevant to wage employment, self-employment, and entrepreneurship.

List of Experiment

1. Rate constant of acid catalyzed hydrolysis of sucrose by polarimetric method.
2. Rate constant of acid catalyzed hydrolysis of sucrose by chemical method.
3. Rate constant of FeCl3-catalyzed H_2O_2 decomposition by gasometric method.
4. Degree of hydrolysis of urea hydrochloride by kinetics method.
5. Equilibrium constant of KI + I2 _ KI3 by distribution method.
6. Phase diagram of a binary organic system (Naphthalene and Diphenyl).
7. Determination of solubility and solubility product of sparingly soluble salt conductometrically.
8. Potentiometric titration of a redox system (ferrous ammonium sulfate with $K_2Cr_2O_7$).
9. Adsorption of acetic acid on charcoal to verify Freundlich adsorption isotherm.
10. Determination of half-life of a radionuclide.

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Teaching Methodology:

This course planned in 11 lab experiment and each experiment having 2 hours practical exposure in Chemistry lab. Their continuous evaluation will be performed in each week and weightage given during finalizing of the grade sheet. At the end of this course student will be able to: Understand the applications of the Physical Chemistry in various field.

Evaluation Scheme:

Exams		Marks	Coverage
P-1		15 Marks	Based on Lab Exercises: 1-6
P-2		15 Marks	Based on Lab Exercises: 7-11
Day-to-Day Work	Viva	20 Marks	70 Marks
	Demonstration	20 Marks	
	Lab Record	15 Marks	
	Attendance & Discipline	15 Marks	

Total	100 Marks

Learning Resources:

Study material of Web Technology Lab (will be added time to time): Digital copy will be available on the JUET server.

Text Book

6. Practical Chemistry Labs, by Leonard Saland**, Manufacturer:** Walch Education 015116

Reference Book

7. Green Chemistry, by Sally A. Henrie, CRC Press Published March 18, 2015.
8. Drinking Water Chemistry: A Laboratory Manual by Barbara Hauser, CRC Press Published August 21, 2001.

Semester III

Organic Reaction Mechanisms-I and pericyclic reactions

Title: Organic Reaction Mechanisms-I and pericyclic reactions **Code: 12M11CH301**

L-T-P Scheme: 3-1-0 **Credit: 4**

Prerequisite: The students must be aware of Organic Chemistry up to the graduate level. This knowledge will help to achieve excellence in the identification and characterization of organic compounds as well as excel in Pericyclic and Photochemical Reaction.

Objective:

This course will help the students to upgrade their concepts of structure and reactivity of organic compounds. It also helps in learning of reaction mechanism, Pericyclic and Photochemical reaction. It also elucidates the synthesis of organic compound, and their characterization.

Course Learning Outcomes:

Course Outcome	Description
CO1	The outline, outcomes, and attributes provide students with learning experiences in Organic Chemistry. It develops broad and balanced knowledge and understanding of synthesis and characterizations. Further, it equips students with appropriate tools of analysis to tackle issues and problems in the field of Pericyclic and Photochemical reaction.
CO2	Describe the real-world problems and challenges through applications of the name reaction and various techniques in characterization of organic compounds.
CO3	Develop in students the ability to apply the knowledge and skills they have acquired to the solution of specific theoretical and applied problems in synthesis and characterization of the organic compound.
CO4	Identify and use various analytical techniques in synthesis and characterization of the organic compound to effectively use in Project Management.
CO5	Apply experimental demonstration and validation by using various analytical techniques given in theorem, principles as explained in lectures.
CO6	Demonstrate students with the knowledge and skill base that would enable them

to undertake further studies in synthesis and characterization of the organic compound. It helps to develop a range of generic skills that are relevant to wage employment, self-employment, and entrepreneurship.

Teaching Methodology:

This syllabus has been implemented for helping the students to understand structure reaction mechanism, Pericyclic and Photochemical reaction. The entire syllabus has divided into four units. Each section includes multiple topics to help a student gain a deeper understanding of Physical Chemistry. This course is divide into 42 Lectures, 14 Tutorial, and 14 Experiments. The facility provided in LRC for both textbooks of ebook for getting a better understanding of students. The NPTEL lecture was also made available to students.

Course Content:

UNIT-I

Aliphatic Nucleophilic Substitution Mechanisms Nucleophilic substitution: Substitution reactions of ambient nucleophile, neighboring group participation of O, S, N, halogens, aryl groups, alkyl and cycloalkyl groups in nucleophilic substitution reactions. Sigma, Pi bond participation in acylic and bicyclic systems (Non-classic carbocations)' Substitution at allylic, trigonal and Vinylic carbons, hydrolysis of esters, Meyer's aldehyde, ketones and carboxylic acids, alkylation with triakyl boranes. Aliphatic Electrophilic substitutions: SE1 SE2 and SEi mechanisms hydrogen exchange, migration of double bonds, halogenations of aldehyde, ketones, acids, acylhalides sulphoxides and sulphones, aliphatic diazonium coupling, nitrosation at Carbon and nitrogen diazo transfer reaction carbene and nitrene insertion, formation of sulphur yield, metalation with organometallic compounds and with metals. Decarboxylation of aliphatic acids. Haloform reaction and Haller-Baner reaction.

UNIT-II

Aromatic nucleophilic substitution: A general introduction to different mechanisms of aromatic Substitution SN Ar, AN and aryne Von Richter rearrangement, sommlet, Hauser rearrangement Smiles rearrangement. Radical substitution Mechanism: Reaction at Sp3 carbon: Reactivity in aliphatic substrates reactivity at bridged position, reactivity at Sp2 carbon. Reactivity in aromatic substrates, neighboring group assistance in free radical reactions, effect of reactivity in the attacking radical effect of solvent on reactivity halogenations at an alkyl carbon and allylic carbon, hydroxylation at aromatic carbon by means of Fenton's reagent, oxidation of aldehyde to

carboxylic acids, formation of cyclic ethers with Pb(OAC)4 Reed reaction, sandmayer reaction, kolbe reaction and Hunsdiecker reaction.

UNIT-III

Molecular orbital symmetry, frontier orbitals of ethylene, 1, 3 Butadiene, 1, 3, 5- Hexatriene, allyl system, classification of pericyclic reactions FMO approach, Woodward- Hoffman correlation diagram method and perturbation of molecular (PMO) approach for the explanation of pericyclic reactions under thermal and photochemical conditions. Electrocyclic Reactions: Conrotatory and disotatory motions (4n) and (4n+2), allyl systems and secondary effects. Cycloadditions: Antarafacial and suprafacial additions, notation. of cycloadditions, (4n) and (4n+2) systems with a greater emphasis on (2+2) and (4+4) - cycloadditions, (2+2) – additions of ketones secondary effects of substitutes on the rates of cycioadditions and chelotropic reactions.

UNIT-IV

FMO approach and perturbation of molecular (PMO) approach for the explanation of sigma tropic rearrgements under thermal and photochemical conditions. suprafacial and antarafacial shifts of H Sigmatropic shift involving carbon moieties, retention and inversion of configurations, (3.3) and (5.5) sigmatropic rearrangements detailed treatment of Claisen and Cope rearrangements fluxional tautomerism, aza-Cope rearrangements and Barton reaction.

Book recommended

1) Advanced Organic Chemistry: Reactions Mechanisms and Structure by Jerry March, McGraw Hill and Kogakush.
2) Molecular reactions and Photochemistry by Charles Dupey and O. Chapman, Prentice Hall.
3) Pericyclic reactions by S.N. Mukharji, Mcmilan.

Reference Books:

1) Mechanisms and Theory in Organic Chemistry by T.H. Lowery and K.S. Rich gardson.
2) The modern structural theory in Organic ChAmistry by L.N.Ferguson, Pretice Hall
3) Physical Organic Chemistry by jack Hine, Mc. Graw Hill.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1 and Unit-2
Test-2	25 Marks	Based on Unit-2 & Unit-3 (80 %) and around 20% from coverage of Test-1

Test-3	35 Marks	Based on Unit-3 to Unit-4 (80%) and around 20% from coverage of Test-1 and Text-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

4) Learning Resources:

5) Tutorials and lecture slide on Web Development (will be added from time to time): Digital copy will be available on the JUET server.

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Organic Spectroscopy – I

Title: Organic Spectroscopy – I **Code: 12M11CH302**

L-T-P Scheme: 3-1-0 **Credit: 4**

Prerequisite: The students must be aware of Spectroscopy to the graduate level. This knowledge will help to achieve excellence in the identification and characterization of organic compounds as well as excel in Spectroscopy.

Objective:

This course will help the students to upgrade their concepts of characterization of organic compound. It also helps in learning of UV/Visible, IR, NMR spectroscopy and Chromatography. It also elucidates the characterization of organic compound.

Course Learning Outcomes:

Course Outcome	Description
CO1	The outline, outcomes, and attributes provide students with learning experiences in Organic Spectroscopy. It develops broad and balanced knowledge and understanding of UV/Visible, IR, NMR spectroscopy and Chromatography. Further, it equips students with appropriate tools of analysis to tackle issues and problems in the field of Organic Chemistry
CO2	Describe the real-world problems and challenges through applications of the name reaction and various techniques in characterization of organic compounds.
CO3	Develop in students the ability to apply the knowledge and skills they have acquired to the solution of specific theoretical and applied problems characterization of the organic compound.
CO4	Identify and use various spectroscopy and chromatography in characterization of the organic compound to effectively use in Project Management.
CO5	Apply experimental demonstration and validation by using various analytical techniques given in theorem, principles as explained in lectures.
CO6	Demonstrate students with the knowledge and skill base that would enable them to undertake further studies in synthesis and characterization of the organic compound. It helps to develop a range of generic skills that are relevant to wage

employment, self-employment, and entrepreneurship.

Teaching Methodology:

This syllabus has been implemented for helping the students to understand structure UV/Visible, IR, NMR spectroscopy and Chromatography. The entire syllabus has divided into four units. Each section includes multiple topics to help a student gain a deeper understanding of Physical Chemistry. This course is divide into 42 Lectures, 14 Tutorial, and 14 Experiments. The facility provided in LRC for both textbooks of ebook for getting a better understanding of students. The NPTEL lecture was also made available to students.

Course Content:

UNIT-I

Infrared spectroscopy: Units of frequency wave length and wave number, molecular vibrations, factors influencing vibrational frequencies, the IR spectrometer, sampling techniques, characteristic frequencies of organic molecules and interpretation of spectra.

UNIT-II

Ultraviolet spectroscopy: Introduction. the absorption laws, measurement of the spectrum, chromophores, standard works of reference, definitions, applications of UV spectroscopy to Conjugated dines, trienes, unsaturated carbonyl compounds and aromatic compounds.

UNIT-III

Nuclear Magnetic Resonance Spectroscopy (Proton and Carbon -13 NMR) The measurement of spectra: the chemical shift: the intensity of NMR signals and integration factors affecting the chemical shifts: spin-spin coupling to 13C IH-IH first order coupling: some simple IH-IH splitting spatterns: the magnitude of IH-IH coupling constants: Mass spectroscopy: Basic Principles: instrumentation: the mass spectrometer, isotope abundances; the molecular ion, meta-stable ions

UNIT-IV

Separation techniques; solvent extraction Chromatography – Paper – thin layer partition –column chromatography. Electrophoresis.

Text books:

1) Spectroscopic Methods in Organic Chemistry. Forth Edition D.M. Williams and I. Fleming Tata - McGraw Hill, New Delhi, 1990. For all spectral methods except ORD and CD and ESR.
2) Organic Spectroscopy, Second Edition, W. Kemp, ELBS Macmillan, 1987 for ORD and CD and ESR.

Books in Reference:

1) Book 2 mentioned above.
2) Applications of absorption spectroscopy of Organic Compounds J.R. Dyer, Prentice Hall of India, New Delhi, 1984.
3) Spectrometric identification of Organic Compounds, Fourth Edition, R.M. Silverstein: G.C.Vassiellr and T.C. Merill, Johne Willey, Singapore, 1981.
4) For ORD and CD "Applications of Optical rotation and Circular Dichroism", G.C. Barret, in "Elucidation of Organic structures by Physical and Chemical Methods" Part I (Eds) K.W. Bentley and G.W. Kirty John Wiley, 1972.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1 and Unit-2
Test-2	25 Marks	Based on Unit-2 & Unit-3 (80 %) and around 20% from coverage of Test-1
Test-3	35 Marks	Based on Unit-3 to Unit-4 (80%) and around 20% from coverage of Test-1 and Text-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

1) **Learning Resources:**
2) Tutorials and lecture slide on Web Development (will be added from time to time): Digital copy will be available on the JUET server.

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Organic Synthesis-1

Title: Organic Synthesis-I **Code: 12M11CH303**

L-T-P Scheme: 3-1-0 **Credit: 4**

Prerequisite: The students must be aware of Organic Chemistry up to the graduate level. This knowledge will help to achieve excellence in the identification and characterization of organic compounds as well as excel in Organoboranes, Methods of polymerization organic compounds.

Objective:

This course will help the students to upgrade their concepts of structure and reactivity of aromatic compounds. It also helps in learning of Organic Synthesis. It also elucidates the organic compounds, synthesis, and their characterization.

Course Learning Outcomes:

Course Outcome	Description
CO1	The outline, outcomes, and attributes provide students with learning experiences in Organic Chemistry. It develops broad and balanced knowledge and understanding of synthesis and characterizations. Further, it equips students with appropriate tools of analysis to tackle issues and problems in the field of Organic Synthesis.
CO2	Describe the real-world problems and challenges through applications of the aromatic, non-aromatic, and heterocyclic organic compounds.
CO3	Develop in students the ability to apply the knowledge and skills they have acquired to the solution of specific theoretical and applied problems in synthesis and characterization of the organic compound.
CO4	Identify and use various analytical techniques in synthesis and characterization of the organic compound to effectively uses in Project Management.
CO5	Apply experimental demonstration and validation by using various analytical techniques given in theorem, principles as explained in lectures.
CO6	Demonstrate students with the knowledge and skill base that would enable them to undertake further studies in synthesis and characterization of the organic

compound. It helps to develop a range of generic skills that are relevant to wage employment, self-employment, and entrepreneurship.

Teaching Methodology:

This course has been introducing to help students understanding the structure, reactivity, stereochemistry of Organic compounds. It also deals with a few natural products considering their importance in medicine and the synthetic industry. The entire course has been broking down into four units. Each section includes multiple topics to help a student gain a deeper understanding of Organic Chemistry. This course has been dividing into 42 Lectures, 14 Tutorial, and 12 Experiments. The facility provided in LRC for both textbooks of ebook for getting a better understanding of students. The NPTEL lecture was also made available to students.

COURSE CONTENT

UNIT-I

Formation of Carbon-Carbon single bonds: alkylation via enolate the enamine and related reactions umplong (dipole inversion) - The aldol reaction- applications of organ palladium, organo nickel and organo copper reagents , applications of thiocarbonions- selenocarbonions and sulphur yields, synthetic applications of carbenes and carbenoids.

UNIT-II

Formation of carbon-carbon double bonds: Elimination reactions Pyrolytic, syneliminations, sulphoxide-sulphonate rearrangement the witting reaction-alkenes form aryl sluphonyl-hydrazones-claisen rearrangement of allyl vinyl ethers.

UNIT-III

Methods of polymerization (a) Addition polymerization (b) Condensation polymerization and (c) Radical polymerizations (two examples of each method). Reactions of inactivated carbon hydrogen

bonds: The Hoffmann Lieffier- Freytag reaction-the Barton reaction-Photolysis of organic hypothalites.

UNIT-IV

Synthetic applications of organobornaes Organoboranes: Preparation of Organobornaes viz hydroboration with BH3-THF, dicylohexyl borane, disamyl borane, theryl borane, 9-BBN and disopincamphlyel borne, functional group transformations of Organo boranes-Oxidation,

protonolysis and rearrangements. Formation of carbon-carbon-bonds viz organo boranes carbonylation, the cyanoborate process and reaction of alkenyl boranes and trialkenyl borates.

Textbooks:

1) Some Modem Methods of Organic Synthesis W. Carothers, Third Edition, Cambridge University Press, Cambridge, 1988.
2) Organic Synthesis: The disconnection approach, S. Warrant John Wiley & sons, New York, 1984.

Books for Reference:

1) Modern Synthetic Reactions, Herbet O. House, Second Edition, W.A. Benzamine Inc. Menio Park, California, 1972.
2) Organic Synthesis viz Boranes, Herbet C. Brown Gray, W. Kramer Alan B. Levy and M. Mark Midland John Wiely & Sons, New York, 1975.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1 and Unit-2
Test-2	25 Marks	Based on Unit-2 & Unit-3 (80 %) and around 20% from coverage of Test-1
Test-3	35 Marks	Based on Unit-3 to Unit-4 (80%) and around 20% from coverage of Test-1 and Text-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

1) **Learning Resources:**
2) Tutorials and lecture slide on Web Development (will be added from time to time): Digital copy will be available on the JUET server.

Natural Products and Biopolymers-I

Title: Natural Products and Biopolymers-I **Code: 12M11CH304**
L-T-P Scheme: 3-1-0 **Credit: 4**

Prerequisite: The students must be aware of Organic Chemistry up to the graduate level. This knowledge will help to achieve excellence in the identification and characterization of organic compounds as well as excel in natural product and biopolymer.

Objective:

This course will help the students to upgrade their concepts of natural product and biopolymer-I. It also helps in learning of Terpenoids, Alakloids, and Biopolymer. It also elucidates the organic compounds, synthesis, and their characterization.

Course Learning Outcomes:

Course Outcome	Description
CO1	The outline, outcomes, and attributes provide students with learning experiences in Terpenoids, Alakloids, and Biopolmer. It develops broad and balanced knowledge and understanding of synthesis and characterizations. Further, it equips students with appropriate tools of analysis to tackle issues and problems in the field of Organic Synthesis.
CO2	Describe the real-world problems and challenges through applications of the Terpenoids, Alakloids, and Biopolymer.
CO3	Develop in students the ability to apply the knowledge and skills they have acquired to the solution of specific theoretical and applied problems in synthesis and characterization of the natural product and biopolymer.
CO4	Identify and use various analytical techniques in synthesis and characterization of the organic compound to effectively uses in Project Management.
CO5	Apply experimental demonstration and validation by using various analytical techniques given in theorem, principles as explained in lectures.
CO6	Demonstrate students with the knowledge and skill base that would enable them to undertake further studies in synthesis and characterization of Terpenoids, Alakloids, and Acetogenin. It helps to develop a range of generic skills that are

relevant to wage employment, self-employment, and entrepreneurship.

Teaching Methodology:

This course has been introducing to help students understanding the synthesis and characterization of Terpenoids, Alakloids, and Acetogenin.. It also deals with a few natural products and biopolymer considering their importance in medicine and the synthetic industry. The entire course has been broking down into four units. Each section includes multiple topics to help a student gain a deeper understanding of Organic Chemistry. This course has been dividing into 42 Lectures, 14 Tutorial, and 12 Experiments. The facility provided in LRC for both textbooks of ebook for getting a better understanding of students. The NPTEL lecture was also made available to students.

COURSE CONTENT

Study of isolation, structure, stereochemistry, synthesis, biogenesis and biological properties of the following classes of natural products from plant, animal, and microbial sources and biopolymers.

UNIT-I

Acetogenins and shikimates: Microbial metabolites: Penicillin G, Cephalosporin-Ö and streptomycin.

UNIT-II

Terpenes: Forskolin, taxol and azadirachtin.

UNIT-III

Alkaloids: Morphine, reserpine and vincristine

UNIT-IV

Biopolymers: Peptides: Amino acids, their general properties and synthesis, Synthesis of peptides by Merrifield solid phase synthesis. Chemistry of oxytocin and dolastain-10.

.**Reference Material:**

1) Organic Chemistry, Volume 2. Stereochemistry and chemistry of natural products, I.L. Finar, 5* Edition, ELBS, 1975
2) Chemical Aspects of Biosynthesis, John Mann, Oxford University Press, Oxford, 1996
3) Chemistry of Natural Products: A Unified Approach, N.R. Krishnaswamy, University Press (India) Ltd., Orient Longman Limited, Hyderabad, 1999.

4) Introduction to Organic Chemistry, A Streitweiser, CH Heathcock and E.M/ Kosover IV Eeition, Me.Milan, 1992.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1 and Unit-2
Test-2	25 Marks	Based on Unit-2 & Unit-3 (80 %) and around 20% from coverage of Test-1
Test-3	35 Marks	Based on Unit-3 to Unit-4 (80%) and around 20% from coverage of Test-1 and Text-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

1) Learning Resources:

2) Tutorials and lecture slide on Web Development (will be added from time to time): Digital copy will be available on the JUET server.

Research Project-I

Title: Research Project-I **Code: 12M17CH371**

L-T-P Scheme: 0-0-4 **Credit: 2**

Prerequisite: The students must be aware of experiment in the area of Chemistry. This knowledge helps them to correlate and adopt at Master Level (Post Graduate).

Objective:

The purpose behind this course is to make the students upgrade the concepts and analyze their application in the commercial and applied level of Chemistry. The objective of this course is to prepare students ready for the future.

Course Learning Outcomes:

Course Outcome	Description
CO1	The outline, outcomes, and attributes provide students with learning experiences that help in achieving deep interests in learning Chemistry. It will develop broad and balanced knowledge and understanding of the concepts of key chemical, principles, and theories related to Chemistry; and equip students with appropriate tools of analysis to tackle issues and problems in the field of Physical chemistry.
CO2	Describe the real-world problems, challenges with the application of the Chemistry.
CO3	Develop in students the ability to apply the knowledge and skills they have acquired to the solution of specific theoretical and applied problems in Chemistry.
CO4	Identify and use various analytical techniques in Project management.
CO5	Apply experimental demonstration and validation by using various analytical techniques given in theorem, principles as explained in lectures.
CO6	Demonstrate students with the knowledge and skill base that would enable them to undertake further studies in Chemistry. It helps to develop a range of generic skills that are relevant to wage employment, self-employment, and entrepreneurship.

List of Experiment

Students are supposed to carry out the Research project on modern concept of synthetic organic chemistry.

1. Literature survey
2. Finalization of problem
3. Preliminary work

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Teaching Methodology:

This course planned in 4 hours practical exposure in Chemistry lab. Their continuous evaluation will be performed in each week and weightage given during finalizing of the grade sheet. At the end of this course student will be able to: Understand the applications of the Chemistry in various field.

Evaluation Scheme:

Exams		Marks	Coverage
P-1		15 Marks	Based on Lab Exercises: 1-6
P-2		15 Marks	Based on Lab Exercises: 7-11
Day-to-Day Work	Viva	20 Marks	70 Marks

Semester IV

Organic Reaction Mechanisms-II and Organic Photochemistry

Title: Organic Reaction Mechanisms-II and Organic Photochemistry Code: 12M11CH401

L-T-P Scheme: 3-1-0 Credit: 4

Prerequisite: The students must be aware of Organic Chemistry up to the graduate level. This knowledge will help to achieve excellence in the identification and characterization of organic compounds as well as excel in Organic Reaction and Photochemical Reaction.

Objective:

This course will help the students to upgrade their concepts of structure and reactivity of organic compounds. It also helps in learning of reaction mechanism and Photochemical reaction. It also elucidates the synthesis of organic compound, and their characterization.

Course Learning Outcomes:

Course Outcome	Description
CO1	The outline, outcomes, and attributes provide students with learning experiences in Organic Chemistry. It develops broad and balanced knowledge and understanding of synthesis and characterizations. Further, it equips students with appropriate tools of analysis to tackle issues and problems in the field of Pericyclic and Photochemical reaction.
CO2	Describe the real-world problems and challenges through applications of the name reaction and various techniques in characterization of organic compounds.
CO3	Develop in students the ability to apply the knowledge and skills they have acquired to the solution of specific theoretical and applied problems in synthesis and characterization of the organic compound.
CO4	Identify and use various analytical techniques in synthesis and characterization of the organic compound to effectively use in Project Management.
CO5	Apply experimental demonstration and validation by using various analytical techniques given in theorem, principles as explained in lectures.

CO6 Demonstrate students with the knowledge and skill base that would enable them to undertake further studies in synthesis and characterization of the organic compound. It helps to develop a range of generic skills that are relevant to wage employment, self-employment, and entrepreneurship.

Teaching Methodology:

This syllabus has been implemented for helping the students to understand structure reaction mechanism, and Photochemical reaction. The entire syllabus has divided into four units. Each section includes multiple topics to help a student gain a deeper understanding of Physical Chemistry. This course is divide into 42 Lectures, 14 Tutorial, and 14 Experiments. The facility provided in LRC for both textbooks of ebook for getting a better understanding of students. The NPTEL lecture was also made available to students.

Course Content:

UNIT-I

Addition Elimination Mechanisms: (a) Addition to carbon multiple bonds- Addition reactions involving electrophiles, necleophiles and free radicals, cyclic mechanisms, orientation and stereochemistry, hydrogenation of double and triple bonds, hydroboration, birch reduction. Michael reaction, addition of oxygen and Nitrogen (b) Addition to carbon-hetero atom multiple bonds: Mannich reaction AH reductions of Carbonyl compounds acids, esters, nitrites, addtion of Grignard reagents, Reformatsky reaction, Tollen's reaction, witting reaction, Prins reaction: (c) Elimination reactions: Stereochemistry of eliminations in acyclic and cyclic systems, orientation in eliminations - Saytzeff and Hoffman elimination propolitic elimination.

UNIT-II

Rearrangements: Classfication and general mechanistic treatment of nucleophilic, free radical and electrophilic rearrangements, Wagner - Meerwein and related reactions Tiffeman Demzanox rearrangement, a- ketone arrangement, Neber, Hofmann, Bayer- villiger, stevens wittig rearrangements.

UNIT-III

Organic Photochemistry: Photoehemical energy plank Condon Principle, Jabionski diagram singlet and triplet states, dissipation of photochemical energy, photosensitization, quenching, quantum efficiency and quantum yield, experimental methods of photochemistry.Photochemistry

of carbonyl compoundsn- n–π, π=π* transitions Norrish type I and Norrish type II cleavages, patterno-Buchi reaction.

UNIT-IV

Photoreduction photochemistry of enone - Hydrogen abstraction, rearrangement of α ; ß - unsaturated ketones and cyclohexadienes, Photochemistry of p- Benzoquinones, photochemistryof unsaturated systems - Olefins, cis trans Isomerisation and dimerization hydrogen abstractions and, addition acetylenes dimerisation, dienes - Photochemistry of 1,3 butadienes (2+2) additions leading to cage structures photochemistry .of cyclohexadienes. Photochemistry of aromatic compounds - Excited state of benzene its 1,2-1,3 1-4 additions, photo Fries rearrangements, photofries reactions of anilides, photosubstitution reactions of bermene derivatives. Photochemistry of pyridinium yields, pyrolysis of nitrites esters and barton reaction. -

Text books:

1) Advanced Organic Chemistry: Reactions Mechanisms and Structure by Jerry March, Me.Graw Hill and Kogakush.
2) Molecular reactions and Photochemistry by Charles Dupey and O. Chapman, Prentice Hall.

Reference Books:

1) Mechanisms and Theory in Organic Chemistry by T.H. Lowery and K.S. Rich gardson.
2) The modern structural theory in Organic Chemistry by L.N.Ferguson, Pretice Hall
3) Physical Organic Chemistry by jack Hine, Mc. Graw Hill

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Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1 and Unit-2
Test-2	25 Marks	Based on Unit-2 & Unit-3 (80 %) and around 20% from coverage of Test-1
Test-3	35 Marks	Based on Unit-3 to Unit-4 (80%) and around 20% from coverage of Test-1 and Text-2
Assignment	10 Marks	
Tutorials	5 Marks	

Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

6) Learning Resources:

7) Tutorials and lecture slide on Web Development (will be added from time to time): Digital copy will be available on the JUET server.

Organic Spectroscopy –II

Title: Organic Spectroscopy –II **Code: 12M11CH402**

L-T-P Scheme: 3-1-0 **Credit: 4**

Prerequisite: The students must be aware of Spectroscopy to the graduate level. This knowledge will help to achieve excellence in the identification and characterization of organic compounds as well as excel in ORD, CD, IR, NMR and Mass Spectroscopy.

Objective:

This course will help the students to upgrade their concepts of characterization of organic compound. It also helps in learning of ORD, CD, IR, NMR and Mass Spectroscopy. It also elucidates the characterization of organic compound.

Course Learning Outcomes:

Course Outcome	Description
CO1	The outline, outcomes, and attributes provide students with learning experiences in Organic Spectroscopy. It develops broad and balanced knowledge and understanding of ORD, CD, IR, NMR and Mass Spectroscopy. Further, it equips students with appropriate tools of analysis to tackle issues and problems in the field of Organic Chemistry
CO2	Describe the real-world problems and challenges through applications of the name reaction and various techniques in characterization of organic compounds.
CO3	Develop in students the ability to apply the knowledge and skills they have acquired to the solution of specific theoretical and applied problems characterization of the organic compound.
CO4	Identify and use various ORD, CD, IR, NMR and Mass Spectroscopy in characterization of the organic compound to effectively use in Project Management.
CO5	Apply experimental demonstration and validation by using various analytical techniques given in theorem, principles as explained in lectures.
CO6	Demonstrate students with the knowledge and skill base that would enable them to undertake further studies in synthesis and characterization of the organic

compound. It helps to develop a range of generic skills that are relevant to wage employment, self-employment, and entrepreneurship.

Teaching Methodology:

This syllabus has been implemented for helping the students to understand structure ORD, CD, IR, NMR and Mass Spectroscopy. The entire syllabus has divided into four units. Each section includes multiple topics to help a student gain a deeper understanding of Physical Chemistry. This course is divide into 42 Lectures, 14 Tutorial, and 14 Experiments. The facility provided in LRC for both textbooks of ebook for getting a better understanding of students. The NPTEL lecture was also made available to students.

Course Content:

UNIT-I

Optical rotatory dispersion and circular dichroism: Phenomena of ORD and CD. Classification of ORD and CD Curves; Cotton effect curves and their application to stereochemical problems; the Octant rule and its application to alicyclic ketones.

UNIT-II

Improving the NMR spectrum: the mean, pulse experiment, new techniques in FT-NMR.spectroscopy: the separation of chemical shift and coupling on to different axes (2DNMR, cosy), spin decoupling, the nuclear over hauser effect associating the signals from directly bonded 13 C arid IH. ESR Derivative curves: values and hyperfine splitting.

UNIT-III

Fragrmentation processes; fragmentation associated with functional groups; rearrangement and mass spectra of some chemical classes. Structural elucidation of Organic compounds by a combined application of the special methods of Units 1-III.

UNIT-IV

Separation Techniques; Instrumentation – Gas Chromatography, High performance Liquid Chromatography, X – Ray diffraction (XRD)

Text_books:

1) Spectroscopic Methods in Organic Chemistry. Forth Edition D.M. Williams and I. Fleming Tata - McGraw Hill, New Delhi, 1990. For all spectral methods except ORD and CD and ESR.

2) Organic Spectroscopy, Second Edition, W.Kemp, ELBS Macmillan, 1987 for ORD and CD and ESR.

Books in reference :

1) Book 2 mentioned above.
2) Applications of absorption spectroscopy of Organic Compounds J. R. Dyer, Prentice Hall of India, New Delhi, 1984.

3) Spectrometric identification of . Organic Compounds, Fourth Edition, R.M. Silverstein; G.C.Vasslellr and T.C. Merill, Johne Willey, Singapore, 1981.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1 and Unit-2
Test-2	25 Marks	Based on Unit-2 & Unit-3 (80 %) and around 20% from coverage of Test-1
Test-3	35 Marks	Based on Unit-3 to Unit-4 (80%) and around 20% from coverage of Test-1 and Text-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

3) Learning Resources:

4) Tutorials and lecture slide on Web Development (will be added from time to time): Digital copy will be available on the JUET server.

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Organic Synthesis-II

Title: Organic Synthesis-II **Code: 12M11CH403**

L-T-P Scheme: 3-1-0 **Credit: 4**

Prerequisite: The students must be aware of Organic Chemistry up to the graduate level. This knowledge will help to achieve excellence in the identification and characterization of organic compounds as well as excel in Organo silanes., Design of Organic Synthesis.

Objective:

This course will help the students to upgrade their concepts of Organo silanes., Design of Organic Synthesis. It also helps in learning of Organic Synthesis. It also elucidates the organic compounds, synthesis, and their characterization.

Course Learning Outcomes:

Course Outcome	Description
CO1	The outline, outcomes, and attributes provide students with learning experiences in Organo silanes., Design of Organic Synthesis. It develops broad and balanced knowledge and understanding of synthesis and characterizations. Further, it equips students with appropriate tools of analysis to tackle issues and problems in the field of Organic Synthesis.
CO2	Describe the real-world problems and challenges through applications of the aromatic, non-aromatic, and heterocyclic organic compounds.
CO3	Develop in students the ability to apply the knowledge and skills they have acquired to the solution of specific theoretical and applied problems in synthesis and characterization of the organic compound.
CO4	Identify and use various analytical techniques in synthesis and characterization of the organic compound to effectively uses in Project Management.
CO5	Apply experimental demonstration and validation by using various analytical techniques given in theorem, principles as explained in lectures.
CO6	Demonstrate students with the knowledge and skill base that would enable them to undertake further studies in synthesis and characterization of the organic

compound. It helps to develop a range of generic skills that are relevant to wage employment, self-employment, and entrepreneurship.

Teaching Methodology:

This course has been introducing to help students understanding the Organo silanes., Design of Organic Synthesis. It also deals with a few natural products considering their importance in medicine and the synthetic industry. The entire course has been broking down into four units. Each section includes multiple topics to help a student gain a deeper understanding of Organic Chemistry. This course has been dividing into 42 Lectures, 14 Tutorial, and 12 Experiments. The facility provided in LRC for both textbooks of ebook for getting a better understanding of students. The NPTEL lecture was also made available to students.

COURSE CONTENT

UNIT-I

Organo silanes. Synthetic applications of trimethylsilyl chloride dimethyl-t-butylsilyl chloride, trimetthylsilyl cyanide, trimethylsilyl iodide and trimethylsilyl triflate, synthetic applications of·. silyl carbanion and B-silyl carbonium ions. Phase transfer catalysis-Principle and applications.

UNIT-II

Oxidation: Oxidations of hydrocarbons, aikenes, alcohols aldehydes and ketones oxidative coupling reactions. Use of Pb (OAC)4, NBs.. CRO3, SeO2, NinO2 Dc- alkoxyluphonium yields, KMnO4, OsO4, peracids and Ti (III) nitrate.

UNIT-III

REDUCTION: Catalytic hydrogenation (homogeneous and heterogeneous), reduction by dissolving metals. reduction by hydride transfer -reagents, reduction with hydrazine and diamide, selectivity in reduction of nitroso and ritro compounds, reductive cleavage.

UNIT-IV

Design of Organic Synthesis: Retro synthesis the disconnection approach-basic principles convergent and linear synthesis.

Textbooks:

1) Some Modern Methods of Organic Synthesis W. Carothers, Third Edition, Cambridge University Press, Cambridge, 1988.
2) Organic Synthesis: The disconnection approach, S. Warrant John Wiley & sons, New York, 1984.

Books for Reference:

1) Modern Synthetic Reactions, Herbet O. Horase, Second Edition, W.A. Benzamine Inc. Menio Park, California, 1972.
2) Organic Synthesis viz Boranes, Herbet C. Brown Gray, W. Kramer Alan B. Levy and M. Mark Midland John Wiely &. Sons, New York, 1975.

Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1 and Unit-2
Test-2	25 Marks	Based on Unit-2 & Unit-3 (80 %) and around 20% from coverage of Test-1
Test-3	35 Marks	Based on Unit-3 to Unit-4 (80%) and around 20% from coverage of Test-1 and Text-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

3) Learning Resources:

4) Tutorials and lecture slide on Web Development (will be added from time to time): Digital copy will be available on the JUET server.

Natural Products and Biopolymers-II

Title: Natural Products and Biopolymers-II **Code: 12M11CH404**

L-T-P Scheme: 3-1-0 **Credit: 4**

Prerequisite: The students must be aware of Organic Chemistry up to the graduate level. This knowledge will help to achieve excellence in the identification and characterization of organic compounds as well as excel in natural product and biopolymer.

Objective:

This course will help the students to upgrade their concepts of natural product and biopolymer-I. It also helps in learning of Terpenoids, Alakloids, and Biopolymer. It also elucidates the organic compounds, synthesis, and their characterization.

Course Learning Outcomes:

Course Outcome	Description
CO1	The outline, outcomes, and attributes provide students with learning experiences in Terpenoids, Alakloids, and Biopolmer. It develops broad and balanced knowledge and understanding of synthesis and characterizations. Further, it equips students with appropriate tools of analysis to tackle issues and problems in the field of Organic Synthesis.
CO2	Describe the real-world problems and challenges through applications of the Terpenoids, Alakloids, and Biopolymer.
CO3	Develop in students the ability to apply the knowledge and skills they have acquired to the solution of specific theoretical and applied problems in synthesis and characterization of the natural product and biopolymer.
CO4	Identify and use various analytical techniques in synthesis and characterization of the organic compound to effectively uses in Project Management.
CO5	Apply experimental demonstration and validation by using various analytical techniques given in theorem, principles as explained in lectures.
CO6	Demonstrate students with the knowledge and skill base that would enable them to undertake further studies in synthesis and characterization of Terpenoids,

Alakloids, and Acetogenin. It helps to develop a range of generic skills that are relevant to wage employment, self-employment, and entrepreneurship.

Teaching Methodology:

This course has been introducing to help students understanding the synthesis and characterization of Terpenoids, Alakloids, and Acetogenin.. It also deals with a few natural products and biopolymer considering their importance in medicine and the synthetic industry. The entire course has been broking down into four units. Each section includes multiple topics to help a student gain a deeper understanding of Organic Chemistry. This course has been dividing into 42 Lectures, 14 Tutorial, and 12 Experiments. The facility provided in LRC for both textbooks of ebook for getting a better understanding of students. The NPTEL lecture was also made available to students.

COURSE CONTENT

Study of isolation, structure, stereochemistry, synthesis, biogenesis and biological properties of the following classes of natural products from plant, animal, and microbial sources and biopolymers.

UNIT-1

Acetogenins and shikimates: Prostaglandin 15 R F GAy podophyllotoxin, etoposide and rotenone.

UNIT-II

Terpenes and Steroids: cholesterol, progesterone And β- amyrin.

UNIT-III

Alkaloids: strychnine, colchicines and camptothecin.

UNIT-IV

Nucleic acids: Basic concepts of the structures of RNA and DNA and their hydrolysis products nucleotides, nucleosides and heterocyclic bases.

Reference Material:

1) Organic Chemistry, Volume 2, Stereochemistry and chemistry of natural products, I.L. Finar, 5th Edition. ELBS, 1975 (overall and for Unit IA., cholesterol, progesterone, and Unit TV).
2) Chemical A spects of Biosynthesis, John Mann, Oxford University Press, Oxford, 1996
3) Chemistiy of Natural Productc· . A Unified Approach, N.R. Krishnaswamy, Universe.y Press (India) Ltd., Orient Longman Limited, Hyderabad, 1999.

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Evaluation Scheme:

Exams	Marks	Coverage
Test-1	15 Marks	Based on Unit-1 and Unit-2
Test-2	25 Marks	Based on Unit-2 & Unit-3 (80 %) and around 20% from coverage of Test-1
Test-3	35 Marks	Based on Unit-3 to Unit-4 (80%) and around 20% from coverage of Test-1 and Text-2
Assignment	10 Marks	
Tutorials	5 Marks	
Quiz	5 Marks	
Attendance	5 Marks	
Total	**100 Marks**	

Learning Resources:

Tutorials and lecture slide on Web Development (will be added from time to time): Digital copy will be available on the JUET server.

Research Project-II

Title: Research Project-II **Code: 12M17CH471**

L-T-P Scheme: 0-0-4 **Credit: 2**

Prerequisite: The students must be aware of experiment in the area of Chemistry. This knowledge helps them to correlate and adopt at Master Level (Post Graduate).

Objective:

The purpose behind this course is to make the students upgrade the concepts and analyze their application in the commercial and applied level of Chemistry. The objective of this course is to prepare students ready for the future.

Course Learning Outcomes:

Course Outcome	Description
CO1	The outline, outcomes, and attributes provide students with learning experiences that help in achieving deep interests in learning Chemistry. It will develop broad and balanced knowledge and understanding of the concepts of key chemical, principles, and theories related to Chemistry; and equip students with appropriate tools of analysis to tackle issues and problems in the field of Physical chemistry.
CO2	Describe the real-world problems, challenges with the application of the Chemistry.
CO3	Develop in students the ability to apply the knowledge and skills they have acquired to the solution of specific theoretical and applied problems in Chemistry.
CO4	Identify and use various analytical techniques in Project management.
CO5	Apply experimental demonstration and validation by using various analytical techniques given in theorem, principles as explained in lectures.
CO6	Demonstrate students with the knowledge and skill base that would enable them to undertake further studies in Chemistry. It helps to develop a range of generic skills that are relevant to wage employment, self-employment, and entrepreneurship.

List of Experiment

1. Compilation of work done in III semester
2. New experiment of finalization of product synthesis
3. Final report writing
4. Presentations / publication of the work in conference /journal

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Teaching Methodology:

This course planned in 4 hours practical exposure in Chemistry lab. Their continuous evaluation will be performed in each week and weightage given during finalizing of the grade sheet. At the end of this course student will be able to: Understand the applications of the Chemistry in various field.

Evaluation Scheme:

Exams		Marks	Coverage
P-1		15 Marks	Based on Lab Exercises: 1-6
P-2		15 Marks	Based on Lab Exercises: 7-11
Day-to-Day Work	Viva	20 Marks	70 Marks