

School of Basic Sciences

Department of Chemistry Course Hand-out

States of Matter | CY1106 | 4 Credits | 3 1 0 4

Session: Jul 19 – Nov 19 | Coordinator: Dr. Susruta Samanta | Class: B.Sc. (Hons.) Chemistry – Semester-I

- **A. Introduction:** This course is offered by Dept. of Chemistry as a core subject in the 1st semester of the B.Sc. Chemistry Honours programme, with an emphasis on fundamental understanding of the states of matter. The course explains the properties of the gaseous, liquid, and solid phases. This covers principles of X-ray diffraction, and photochemistry. The course also grows understanding of electrical and magnetic properties of materials. Students are expected to have basic background knowledge of chemistry and mathematics for this course.
- **B.** Course Objectives: At the end of the course, students will be able to
 - [1106.1]. Describe the gaseous state and recognize the transport properties.
 - [1106.2]. Explain the liquid state and describe the colligative properties.
 - [1106.3]. Describe the solid state and acquire the skill to explain X-ray diffraction.
 - [1106.4]. Develop the understanding of the electrical and magnetic properties of materials.
 - [1106.5]. Illustrate the principles of photochemistry.

C. Program Outcomes and Program Specific Outcomes

- **[PO.1].** Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.
- **[PO.2].** Effective Communication: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.
- **[PO.3].** Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.
- **[PO.4].** Effective Citizenship: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.
- **[PO.5].** Ethics: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.
- **[PO.6].** Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.
- **[PO.7].** Self-directed and Life-long Learning: Acquire the ability to engage in independent and lifelong learning in the broadest context socio-technological changes

[PSO.1]. Recognize the fundamental concepts of chemistry and their applications.

[PSO.2]. Employ critical thinking and scientific inquiry in the interpretation of theoretical knowledge at a level suitable for an entry level position in the chemical industry or a post graduate chemistry program.

[PSO.3]. Conceptualize and apply the ideas of chemical sciences in the areas of organic synthesis, synthesis of materials, corrosion inhibition, environment sustainability etc.

D. Assessment Plan:

Criteria	Description	Maximum Marks						
	Sessional Exam I (Closed Book)	20						
Internal Assessment	Sessional Exam II (Closed Book)	20						
(Summative)	Quiz tests and assignments	10						
	(Accumulated and Averaged)							
End Term Exam	End Term Exam (Closed Book)	50						
(Summative)								
	Total	100						
Attendance	A minimum of 75% Attendance is requir	red to be maintained by a student						
(Formative)	to be qualified for taking up the End Sem	ester examination. The allowance						
	of 25% includes all types of leaves includi	ng medical leaves.						
Homework/ Home Assignment/	There are situations where a studen	t may have to work in home,						
Activity Assignment	especially before a flipped classroom. S	Some of these works are graded						
(Formative)	with marks. A student is expected to	participate and perform these						
	assignments with full zeal since the activity/ flipped classroom participation							
	by a student will be assessed and marks w	vill be awarded.						

E. Syllabus

Equation of State: Kinetic molecular theory, kinetic gas equation, imperfection in real gases, compressibility, isotherms, equations of state, van der Waal's equation, liquefaction of gases, critical phenomenon, P-V isotherms of carbon dioxide, principle of continuity of state. Transport Properties: kinetic energy and temperature, distribution of molecular speeds, derivation of Maxwell-Boltzmann distribution law, thermal conductivity, thermal conductivity in gases. Properties of Liquids: The kinetic molecular description, intermolecular forces in, density and its measurements, vapor pressure and its determination, surface tension and its determination, viscosity and measurement of viscosity. Colligative **Properties:** Solutions of non-volatile solutes, colligative properties. **Solid State:** Space lattice, unit cell. Miller indices, symmetry elements in crystals. X-ray diffraction. Bragg's equation, dimension and contents of unit cell. Electric and Magnetic Properties: Electric properties, polarization of molecules in electric field, Clausious-Mosotti equation, Debye equation, bond moments, dipole moment, group moment, magnetic properties, magnetic susceptibility. Photochemistry: General principles of absorption, electronic transition, Jablonski diagram, intersystem crossing, singlet and triplet states, fluorescence, phosphorescence, quantum yield, photochemical reactions of carbonyl compounds, alkenes and aromatic compounds, Barton Reaction, Norrish type I and II reactions, Hofmann-Loffler-Freytag reaction.

F. References

- I. P. Atkins & J. de Paula, Atkins's Physical Chemistry, Oxford University Press, NY, 2004.
- 2. B. R. Puri, L. R. Sharma & M. S. Pathania, Principles of Physical Chemistry, Vishal Publication, 2010.
- 3. D. A. McQuarrie & J. D. Simon, Physical Chemistry: A Molecular Approach, Viva books, 2011.
- 4. G. W. Castellan, Physical Chemistry (3rd Edition), Narosa Publishing House, 2004.
- 5. P. C. Rakshit, Physical Chemistry, Sarat Book House, 2014.

I Lecture Plan:

Lec No	Topics	Session Outcome	Mode of Delivery	Corresp- onding CO	Mode of Assessing the Outcome
١.	Introduction to the course	To acquaint and clear expectations and outcomes from the course	Discussion	1106.1-5	All
2.	The structure of matter	Generalize the concept of the structure of matter	Lecture Discussion	1106.1-5	All
3.	Fundamental concepts: matter, energy, thermodynamics.	Develop necessary basic concepts for the course	Lecture Discussion	1106.1-5	All
4.	Ideal gasses: P, V, T relationships, gas laws	Explain the relationships between physical parameters	Lecture, Discussion	1106.1	Class Quiz End Term
5.	Kinetic molecular theory, Maxwell distribution of molecular velocities	Summarize the kinetic theory of gas	Lecture, Activity	1106.1	Assignment Mid Term I End Term
6.	Collision theory, free path	Interpret the properties of gas in terms of collision theory	Discussion, Activity	1106.1	Mid Term I End Term
7.	Tutorial-I	Summarize the key ideas of the gaseous state	Discussion, Activity	1106.1	Mid Term I End Term
8.	Transport properties	Discuss the transport properties	Lecture, Activity	1106.1	Mid Term I End term
9.	Degrees of freedom, principle of equipartition of energy	Summarize the equipartition principle	Lecture, Activity	1106.1	Mid Term I End Term
10.	Real gasses: Imperfections, deviations	Compare the properties of real and ideal gasses	Discussion, Activity	1106.1	Mid Term I End Term
11.	van der Waal's equation, other equations	Compare the equations of state for real gasses	Lecture, Activity	1106.1	Mid Term I End Term
12.	Tutorial-11	Summarize the key ideas of the gaseous state	Activity	1106.1	Mid Term I End Term
13.	Intermolecular forces, critical phenomena	Summarize the intermolecular forces	Lecture, Activity	1106.1	Mid Term II End Term
14.	Thermal properties	Summarize the thermal properties of gas	Lecture, Activity	1106.1	Mid Term I End Term
15.	Liquefaction of gasses	Explain the liquefaction of gasses	Discussion, Activity	1106.1	Mid Term I End Term
16.	Tutorial-III	Summarize the key ideas of the gaseous state	Discussion, Activity	1106.1	Class Quiz End Term
17.	Molecular interactions	Compare the interaction forces	Discussion, Activity	1106.1-3	Mid Term I End Term
18.	Liquid state: free volume, vapour pressure	Distinguish between the liquid and gaseous state	Lecture, Activity	1106.2	Mid Term I End Term
19.	Surface tension: Theory, measurements	Summarize the properties of surface tension	Lecture, Activity	1106.2	Mid Term I End Term
20.	Viscosity: Theory, measurements, refraction	Summarize the properties of viscosity	Lecture, Activity	1106.2	Class Quiz End Term
21.	Tutorial-IV	Summarize the key ideas of the liquid state	Discussion, Activity	1106.2	Mid Term I End Term
22.	Idea solution, dilute solution	Compare different types of solutions	Lecture, Activity	1106.2	Mid Term I End Term
23.	Colligative properties	Summarize the colligative properties	Lecture, Activity	1106.2	Class Quiz Mid Term I
24.	Liquid crystals: Types, LC display	Develop the concepts for the	Discussion,	1106.2-3	Mid Term I
25.	Equilibria between condensed	Summarize, liquid-liquid, gas-liquid, solid-liquid equilibria	Lecture,	1106.1-3	Mid Term I End Term
26.	Tutorial-V	Summarize the key ideas of the	Discussion,	1106.2	Mid Term I
27.	Photochemistry: Thermal and photochemical processes, laws	Differentiate between photochemical and chemical processes	Lecture, Discussion	1106.5	Mid Term I End Term
28.	Jablonski diagram, fluorescence, phosphorescence	Construct the Jablonski diagram	Lecture, Activity	1106.5	Mid Term II End Term

29.	Non-radioactive processes	Explain non-radioactive processes	Lecture,	1106.5	Assignment
	(internal conversion, inter		Activity		Mid Term I
	system crossing)		,		End Term
30.	Quantum vield, photosensitized	Summarize the properties of	Discussion.	1106.5	Class Quiz
	reactions-energy transfer	photochemistry	Activity		End Term
		photochemistry	receivicy		End renn
21	Parton Poaction Norrich type I	Evolution examples of photoshemical	Locturo		Mid Torm II
51.	Barton Reaction, Norrish type I	Explain examples of photochemical	Lecture,	1106.5	
	and II reactions, Hofmann-	reactions	Activity		End Term
	Loffler-Freytag reaction.				
32	Tutorial-VI	Summarize the key ideas of	Discussion,	1106.5	Assignment
		photochemistry	Flipped class		End Term
33	The solid state: introduction,	Distinguish the solid state from	Lecture,	1106.3	Mid Term II
	structure, classifications	other states based on properties	Activity		End Term
34	Symmetry, point groups	Explore the symmetry elements in	, Lecture.	1106.3	Assignment
		a solid material	Activity		End Term
25	Lattice unit cell lattice energy	Polato symmetry elements to a	Locturo	1104.3	Mid Torm II
55	Lattice, unit cell, lattice ellergy	where a symmetry elements to a		1100.5	
		crystal lattice	Activity		
36	Born-Lande equation	Derive the energetics of crystal	Lecture,	1106.3	Mid Term II
		lattices	Activity		End Term
37	Born-Haber cycle	Derive the energetics of crystal	Discussion,	1106.3	Mid Term II
		lattices	Activity		End Term
38	Tutorial-VII	Summarize the key ideas of the	Discussion,	1106.3	Mid Term II
		solid state	Activity		End Term
39	Law of rational indices. Miller	Derive the Miller indices for	, Lecture.	11063	Mid Term II
	indices	different types of cubic systems			End Term
40	V row differentian Progg aquation	Interent types of cubic systems	Lecture	1106.2	Mid Terma II
40	A-ray dimaction, bragg equation	interpret X-ray diffraction and	Lecture,	1106.5	
		justify its use to determine the	Activity		End Term
		structure of lattices	_		-
41	Experimental methods	Summarize the techniques to	Discussion,	1106.3	Quiz
		determine physical properties of	Activity		Assignment
		solid materials			End Term
42	Tutorial-VIII	Summarize the key ideas of the	Flipped class,	1106.3	Mid Term II
		solid state	Activity		End Term
43	Types of crystals	solid state Compare the properties of	Activity Lecture.	1106.3	End Term Mid Term II
43	Types of crystals	solid state Compare the properties of different type of crystals	Activity Lecture, Activity	1106.3	End Term Mid Term II End Term
43	Types of crystals	solid state Compare the properties of different type of crystals	Activity Lecture, Activity	1106.3	End Term Mid Term II End Term Mid Term II
43 44	Types of crystals Free electron model, Band	solid state Compare the properties of different type of crystals Implement the electronic theories to describe the properties of	Activity Lecture, Activity Lecture, Activity	1106.3 1106.3-4	End Term Mid Term II End Term Mid Term II End Term
43 44	Types of crystals Free electron model, Band theory, Conduction	solid state Compare the properties of different type of crystals Implement the electronic theories to describe the properties of different types of solid materials	Activity Lecture, Activity Lecture, Activity	1106.3	End Term Mid Term II End Term Mid Term II End Term
43	Types of crystals Free electron model, Band theory, Conduction	solid state Compare the properties of different type of crystals Implement the electronic theories to describe the properties of different types of solid materials	Activity Lecture, Activity Lecture, Activity	1106.3	End Term Mid Term II End Term Mid Term II End Term
43 44 45	Types of crystals Free electron model, Band theory, Conduction Imperfections, point defects	solid state Compare the properties of different type of crystals Implement the electronic theories to describe the properties of different types of solid materials Explain the structural defects in a	Activity Lecture, Activity Lecture, Activity Discussion,	1106.3 1106.3-4 1106.3	End Term Mid Term II End Term Mid Term II End Term Mid Term II
43 44 45	Types of crystals Free electron model, Band theory, Conduction Imperfections, point defects	solid state Compare the properties of different type of crystals Implement the electronic theories to describe the properties of different types of solid materials Explain the structural defects in a lattice	Activity Lecture, Activity Lecture, Activity Discussion, Activity	1106.3 1106.3-4 1106.3	End Term Mid Term II End Term II End Term Mid Term II End Term
43 44 45 46	Types of crystals Free electron model, Band theory, Conduction Imperfections, point defects Tutorial-IX	solid state Compare the properties of different type of crystals Implement the electronic theories to describe the properties of different types of solid materials Explain the structural defects in a lattice Summarize the key ideas of the	Activity Lecture, Activity Lecture, Activity Discussion, Activity Discussion,	I 106.3 I 106.3-4 I 106.3 I 106.3	End Term Mid Term II End Term II End Term II Mid Term II End Term Mid Term II
43 44 45 46	Types of crystals Free electron model, Band theory, Conduction Imperfections, point defects Tutorial-IX	solid state Compare the properties of different type of crystals Implement the electronic theories to describe the properties of different types of solid materials Explain the structural defects in a lattice Summarize the key ideas of the solid state	Activity Lecture, Activity Lecture, Activity Discussion, Activity Discussion, Activity	1106.3 1106.3-4 1106.3 1106.3	End Term Mid Term II End Term II End Term Mid Term II End Term Mid Term II End Term II End Term
43 44 45 46 47	Types of crystalsFree electron model, Band theory, ConductionImperfections, point defectsTutorial-IXElectric properties, polarization	solid state Compare the properties of different type of crystals Implement the electronic theories to describe the properties of different types of solid materials Explain the structural defects in a lattice Summarize the key ideas of the solid state Generalize the electrical properties	Activity Lecture, Activity Lecture, Activity Discussion, Activity Discussion, Activity Lecture,	1106.3 1106.3-4 1106.3 1106.3 1106.4	End Term Mid Term II End Term II End Term Mid Term II End Term Mid Term II End Term End Term
43 44 45 46 47	Types of crystalsFree electron model, Band theory, ConductionImperfections, point defectsTutorial-IXElectric properties, polarization of molecules in electric field	solid state Compare the properties of different type of crystals Implement the electronic theories to describe the properties of different types of solid materials Explain the structural defects in a lattice Summarize the key ideas of the solid state Generalize the electrical properties of matters	Activity Lecture, Activity Lecture, Activity Discussion, Activity Discussion, Activity Lecture, Activity	1106.3 1106.3-4 1106.3 1106.3 1106.4	End Term Mid Term II End Term II End Term II End Term II End Term II End Term II End Term End Term
43 44 45 46 47 48	Types of crystals Free electron model, Band theory, Conduction Imperfections, point defects Tutorial-IX Electric properties, polarization of molecules in electric field Electrical conduction	solid state Compare the properties of different type of crystals Implement the electronic theories to describe the properties of different types of solid materials Explain the structural defects in a lattice Summarize the key ideas of the solid state Generalize the electrical properties of matters Generalize the concept of electrical	Activity Lecture, Activity Lecture, Activity Discussion, Activity Discussion, Activity Lecture, Activity Lecture,	1106.3 1106.3-4 1106.3 1106.3 1106.4 1106.4	End Term Mid Term II End Term II End Term II End Term II End Term II End Term II End Term End Term
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43 44 45 46 47 48 49 50 51 51 52 53	Types of crystalsFree electron model, Band theory, ConductionImperfections, point defectsTutorial-IXElectric properties, polarization of molecules in electric fieldElectrical conductionClausious-Mosotti equation, Debye equationBond moments, dipole moment, group momentMagnetic properties, magnetic susceptibilityTutorial-XI	solid state Compare the properties of different type of crystals Implement the electronic theories to describe the properties of different types of solid materials Explain the structural defects in a lattice Summarize the key ideas of the solid state Generalize the electrical properties of matters Generalize the concept of electrical conduction Summarize the essential rules of electrical conduction Summarize the magnetic properties of material Summarize the electric and magnetic properties Summarize the key ideas of the gaseous state	Activity Lecture, Activity Lecture, Activity Discussion, Activity Discussion, Activity Lecture, Activity Lecture, Activity Lecture, Activity Lecture, Activity Lecture, Activity Lecture, Activity Discussion, Activity Discussion, Activity	1106.3 1106.3-4 1106.3 1106.3 1106.4 1106.4 1106.4 1106.4 1106.4 1106.4 1106.4	End Term Mid Term II End Term II End Term II End Term II End Term Mid Term II End Term End Term End Term Quiz End Term Quiz End Term End Term Mid Term I End Term I End Term
43 44 45 46 47 48 49 50 51 52 53 53 54	Types of crystals Free electron model, Band theory, Conduction Imperfections, point defects Tutorial-IX Electric properties, polarization of molecules in electric field Electrical conduction Clausious-Mosotti equation, Debye equation Bond moments, dipole moment, group moment Magnetic properties, magnetic susceptibility Tutorial-XI Tutorial-XII	solid state Compare the properties of different type of crystals Implement the electronic theories to describe the properties of different types of solid materials Explain the structural defects in a lattice Summarize the key ideas of the solid state Generalize the electrical properties of matters Generalize the concept of electrical conduction Summarize the essential rules of electrical conduction Summarize the magnetic properties of material Summarize the electric and magnetic properties Summarize the key ideas of the gaseous state Summarize the key ideas of liquid	Activity Lecture, Activity Lecture, Activity Discussion, Activity Discussion, Activity Lecture, Activity Lecture, Activity Lecture, Activity Lecture, Activity Lecture, Activity Lecture, Activity Discussion, Activity Discussion, Activity Discussion, Activity	1106.3 1106.3-4 1106.3 1106.3 1106.4 1106.4 1106.4 1106.4 1106.4 1106.4 1106.4 1106.4 1106.4	End Term Mid Term II End Term II End Term II End Term II End Term Mid Term II End Term End Term End Term Quiz End Term Quiz End Term End Term Mid Term I End Term
43 44 45 46 47 48 49 50 51 52 53 54	Types of crystalsFree electron model, Band theory, ConductionImperfections, point defectsTutorial-IXElectric properties, polarization of molecules in electric fieldElectrical conductionClausious-Mosotti equation, Debye equationBond moments, dipole moment, group momentMagnetic properties, magnetic susceptibilityTutorial-XITutorial-XII	solid state Compare the properties of different type of crystals Implement the electronic theories to describe the properties of different types of solid materials Explain the structural defects in a lattice Summarize the key ideas of the solid state Generalize the electrical properties of matters Generalize the concept of electrical conduction Summarize the essential rules of electrical conduction Summarize the magnetic properties of material Summarize the electric and magnetic properties Summarize the key ideas of the gaseous state Summarize the key ideas of liquid state	Activity Lecture, Activity Lecture, Activity Discussion, Activity Discussion, Activity Lecture, Activity Lecture, Activity Lecture, Activity Lecture, Activity Lecture, Activity Lecture, Activity Discussion, Activity Discussion, Activity Discussion, Activity	1106.3 1106.3-4 1106.3 1106.3 1106.4 1106.4 1106.4 1106.4 1106.4 1106.4 1106.4 1106.4 1106.4 1106.4 1106.4 1106.4 1106.4 1106.4	End Term Mid Term II End Term II End Term II End Term II End Term Mid Term II End Term End Term End Term Quiz End Term Quiz End Term End Term Mid Term I End Term I End Term
43 44 45 46 47 48 49 50 51 52 53 54 54	Types of crystals Free electron model, Band theory, Conduction Imperfections, point defects Tutorial-IX Electric properties, polarization of molecules in electric field Electrical conduction Clausious-Mosotti equation, Debye equation Bond moments, dipole moment, group moment Magnetic properties, magnetic susceptibility Tutorial-XI Tutorial-XII	solid state Compare the properties of different type of crystals Implement the electronic theories to describe the properties of different types of solid materials Explain the structural defects in a lattice Summarize the key ideas of the solid state Generalize the electrical properties of matters Generalize the concept of electrical conduction Summarize the essential rules of electrical conduction Summarize the magnetic properties of material Summarize the electric and magnetic properties Summarize the key ideas of the gaseous state Summarize the key ideas of liquid state Summarize the key ideas of liquid state	Activity Lecture, Activity Lecture, Activity Discussion, Activity Discussion, Activity Lecture, Activity Lecture, Activity Lecture, Activity Lecture, Activity Lecture, Activity Lecture, Activity Discussion, Activity Discussion, Activity Discussion, Activity	1106.3 1106.3-4 1106.3 1106.3 1106.4 1106.4 1106.4 1106.4 1106.4 1106.4 1106.4 1106.4 1106.4 1106.5	End Term Mid Term II End Term II End Term II End Term II End Term Mid Term II End Term End Term End Term Quiz End Term Quiz End Term End Term Mid Term I End Term Mid Term I End Term
43 44 45 46 47 48 49 50 51 52 53 54 55	Types of crystalsFree electron model, Band theory, ConductionImperfections, point defectsTutorial-IXElectric properties, polarization of molecules in electric fieldElectrical conductionClausious-Mosotti equation, Debye equationBond moments, dipole moment, group momentMagnetic properties, magnetic susceptibilityTutorial-XITutorial-XIITutorial-XIII	solid state Compare the properties of different type of crystals Implement the electronic theories to describe the properties of different types of solid materials Explain the structural defects in a lattice Summarize the key ideas of the solid state Generalize the electrical properties of matters Generalize the concept of electrical conduction Summarize the essential rules of electrical conduction Summarize the magnetic properties of material Summarize the electric and magnetic properties Summarize the key ideas of the gaseous state Summarize the key ideas of liquid state	Activity Lecture, Activity Lecture, Activity Discussion, Activity Discussion, Activity Lecture, Activity Lecture, Activity Lecture, Activity Lecture, Activity Lecture, Activity Lecture, Activity Discussion, Activity Discussion, Activity Discussion, Activity Discussion, Activity	1106.3 1106.3-4 1106.3 1106.4 1106.4 1106.4 1106.4 1106.4 1106.4 1106.4 1106.4 1106.4 1106.4 1106.5	End Term Mid Term II End Term II End Term II End Term II End Term Mid Term II End Term End Term Quiz End Term Quiz End Term End Term Mid Term I End Term Mid Term I End Term
43 44 45 46 47 48 49 50 51 52 53 54 55 54	Types of crystals Free electron model, Band theory, Conduction Imperfections, point defects Tutorial-IX Electric properties, polarization of molecules in electric field Electrical conduction Clausious-Mosotti equation, Debye equation Bond moments, dipole moment, group moment Magnetic properties, magnetic susceptibility Tutorial-XI Tutorial-XII Tutorial-XIII	solid state Compare the properties of different type of crystals Implement the electronic theories to describe the properties of different types of solid materials Explain the structural defects in a lattice Summarize the key ideas of the solid state Generalize the electrical properties of matters Generalize the concept of electrical conduction Summarize the essential rules of electrical conduction Summarize the magnetic properties of material Summarize the electric and magnetic properties Summarize the key ideas of the gaseous state Summarize the key ideas of liquid state	Activity Lecture, Activity Lecture, Activity Discussion, Activity Discussion, Activity Lecture, Activity Lecture, Activity Lecture, Activity Lecture, Activity Lecture, Activity Lecture, Activity Discussion, Activity Discussion, Activity Discussion, Activity Discussion, Activity Discussion, Activity	1106.3 1106.3-4 1106.3 1106.3 1106.4 1106.4 1106.4 1106.4 1106.4 1106.4 1106.4 1106.4 1106.1 1106.2 1106.5	End Term Mid Term II End Term II End Term II End Term II End Term II End Term End Term End Term Quiz End Term Quiz End Term End Term Mid Term I End Term Mid Term I End Term Mid Term II End Term
43 44 45 46 47 48 49 50 51 52 53 54 55 54 55 56	Types of crystalsFree electron model, Band theory, ConductionImperfections, point defectsTutorial-IXElectric properties, polarization of molecules in electric fieldElectrical conductionClausious-Mosotti equationBond moments, dipole moment, group momentMagnetic properties, magnetic susceptibilityTutorial-XITutorial-XIITutorial-XIIITutorial-XIV	solid state Compare the properties of different type of crystals Implement the electronic theories to describe the properties of different types of solid materials Explain the structural defects in a lattice Summarize the key ideas of the solid state Generalize the electrical properties of matters Generalize the concept of electrical conduction Summarize the essential rules of electrical conduction Summarize the magnetic properties of material Summarize the electric and magnetic properties Summarize the key ideas of the gaseous state Summarize the key ideas of liquid state Summarize the key ideas of liquid state Summarize the key ideas of the gaseous state Summarize the key ideas of the gaseous state Summarize the key ideas of the state Summarize the key ideas of the Summarize the key ideas of the	Activity Lecture, Activity Lecture, Activity Discussion, Activity Discussion, Activity Lecture, Activity Lecture, Activity Lecture, Activity Lecture, Activity Lecture, Activity Lecture, Activity Discussion, Activity Discussion, Activity Discussion, Activity Discussion, Activity	1106.3 1106.3-4 1106.3 1106.3 1106.4 1106.4 1106.4 1106.4 1106.4 1106.4 1106.4 1106.4 1106.5 1106.5 1106.3	End Term Mid Term II End Term II End Term II End Term II End Term Mid Term II End Term End Term End Term Quiz End Term End Term Mid Term I End Term Mid Term I End Term Mid Term II End Term

Course Articulation Matrix: (Mapping of COs with POs)

со	Statement	Corre	Correlation with program outcomes						Corre progra outcoi	lation Im mes	with specific
		POI	PO2	PO3	PO4	PO5	PO6	PO7	PSOI	PSO2	PSO3
CY 1106.1	Describe the gaseous state and recognize the transport properties	I					I	2	3	2	2
CY 1106.2	Explain the liquid state and describe the colligative properties	I					I	2	3	2	I
CY 1106.3	Describe the solid state and acquire the skill to explain X- ray diffraction	3					I	3	3	2	2
CY 1106.4	Develop the understanding of the electrical and magnetic properties of materials	3					I	2	I	2	2
CY 1106.5	Illustrate the principles of photochemistry	2					2	2	2	Ι	3

I- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation



School of Basic Sciences

Department of Computer Applications

Course Handout

FUNDAMENTALS OF COMPUTERS | CA 1170 | 2 Credits | 1102

Session: Aug 1 - November 30, 2019

Faculty: Dr. Vanita Jaitly

A. INTRODUCTION

The present era is evolving around computing devices. The one who is lacking the knowledge of computing devices is considered as illiterate. Therefor this course is targeted to bring awareness and knowledge of various computing devices and accessories. The main objectives of the course are as follows:

- Identify the main system elements of a computer system and describe their function.
- Describe the main hardware components of a Personal Computer.
- Describe the main software elements of a computer system.

B. COURSE OUTCOMES

At the end of the course, students will be able to

- [1170.1]. To understand the fundamental concepts of the computer system with the contemporary skill and knowledge.
- **[1170.2].** To analyse and understand the knowledge of computer equipment both hardware and software, which would leverage the options of employability.
- [1170.3]. To describe various operating systems, peripheral devices, networking, multimedia and internet.
- **[1170.4].** Demonstrate and understand the terms and various functions associated with hardware and software program menus of computer systems, amalgamation of which would help a student in enhancing entrepreneurship skills.

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

PROGRAM OUTCOMES

[PO.1]. Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational and personal) from different perspectives.

[PO.2]. Effective Communication: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.

[PO.3]. Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.

[PO.4]. Effective Citizenship: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

[PO.5]. Ethics: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.

[PO.6]. Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.

[PO.7]. Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes.

PROGRAM SPECIFIC OUTCOMES

PSO 1: To apply creativity in support of the design, creation, implementation and inference of contemporary and advanced technologies.

PSO 2: To participate & succeed in IT oriented jobs/competitive examinations that offer inspiring & gratifying careers.

PSO 3: To recognize the importance of professional developments by pursuing postgraduate studies and positions.

D. ASSESSEMENT PLAN

Criteria	Description	Maximum Marks					
	Sessional Exam I (Close Book)	20					
Internal Assessment	Sessional Exam II (Close Book)	20					
(Summative)	In class Quizzes	10					
End Term Exam	End Term Exam (Close Book)	50					
(Summative)							
	Total	100					
Attendance	A minimum of 75% Attendance is requi	red to be maintained by a student to be					
(Formative)	qualified for taking up the End Semester examination. The allowance of 25%						
	includes all types of leaves including medi	cal leaves.					

E. SYLLABUS

CA1170 FUNDAMENTALS OF COMPUTERS [1 1 0 2]

Computer Fundamentals, Definition and Purpose, Data, Information and Knowledge, Characteristics of Computers, Classification of Computers, Generations of Computer, Basic organization of Computer, System Software and Application Software. Operating Systems and Multimedia, Types of Operating System, Windows v/s Linux, Mobile based OS, Multimedia, Definition and Types, Multimedia Software, Computer Networks, Applications of Networking, Network Topologies- Mesh, Bus, Star, Ring, Types of Network (LAN, MAN, WAN), Network Cables- Optical Fiber, Twisted, Co-axial, Network Devices- Hubs, Switch, Router, Network Interface Card, Ethernet, Internet, Introduction and Usage of Internet, Internet Connectivity Options (Wired and Wireless), IP Addressing and DNS, Website, URL, HTML, Web Browser and Search Engines, Operational Guideline of Computer Usage, Do's and Don'ts of Computer, E-mails, Email Etiquettes, Cyber Security, Internet Frauds, Secure Password Formation, Computer Security, Malware, Virus, Ransomware, Social Media and its Impact.

F. TEXT BOOKS

- 1. E. Balagurusamy "Fundamentals of Computers" Published by Tata McGraw-Hill Education Pvt. Ltd.
- 2. P.K.Sinha, "Computers Fundamentals", BPB Publications.

G. REFERENCE BOOKS

- 1.R. Thareja, *Fundamental of Computer*, (1e) Oxford Publications, 2014.
- 2. K. Atul, Information Technology, (3e) Tata McGraw Hill Publication, 2008.

Lecture#	Topics to be Covered
Module I : COM	PUTER FUNDAMENTALS
Lecture 1-3	 Definition and Purpose Data, Information and Knowledge Characteristics of a computer
Module II : CAT	EGORIZATION OF COMPUTERS
Lecture 4-6 Module III : OP	 Classification of Computers Generations of Computer Basic organization of Computer, System Software and Application Software
Lecture 7-8	 Operating Systems and Multimedia Types of Operating System Windows v/s Linux Mobile based OS
Module	IV : MULTIMEDIA
Lecture 9-10	Definition and TypesMultimedia Software
Module V : CC	OMPUTER NETWORKS
Lecture 11- 15	 Computer Networks Applications of Networking Network Topologies- Mesh, Bus, Star, Ring Types of Network (LAN, MAN, WAN) Network Cables- Optical Fiber, Twisted, Co-axial Network Devices- Hubs, Switch, Router, Network Interface Card
Modul	e VI: INTERNET
Lecture 16-19	 Introduction and Usage of Internet Internet Connectivity Options (Wired and Wireless) IP Addressing and DNS, Website, URL, HTML Web Browser and Search Engines
Module VII: OPE	RATIONAL GUIDELINES
Lecture 20-22	 Operational Guideline of Computer Usage Do's and Don'ts of Computer e-mails, email Etiquettes, System Software and Application Software
Module	VIII: SECURITY
Lecture 23-25	 Cyber Security Internet Frauds Secure Password Formation Computer Security Malware, Virus, Ransomware Social Media and its Impact

I. COURSE ARTICULATION MATRIX: (Mapping of COs with POs)

со	STATEMENT		CORRELATION WITH PROGRAM OUTCOMES							CORRELATION WITH PROGRAM SPECIFIC OUTCOMES						
		PO 1	PO 2	PO 3	РО 4	PO 5	РО 6	PO 7	РО 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CS 1170.1	To understand the fundamental concepts of the computer system with the contemporary skill and knowledge.															
CS 1170.2	To analyse and understand the knowledge of computer equipments both hardware and software, which would leverage the options of employability.															
CS 1170.3	To describe various operating systems, peripheral devices, networking, multimedia and internet.															
CS 1170.4	Demonstrate and understand the terms and various functions associated with hardware and software program menus of computer systems, amalgamation of which would help a student in enhancing entrepreneurship skills.															

I- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

J. COURSE OUTCOME ATTAINMENT LEVEL MATRIX

со	STATEMENT		ATTAINMENT OF PROGRAM OUTCOMES THRESHOLD VALUE: 40%											ATTAINMENT OF PROGRAM SPECIFIC OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CS 1170.1	To understand the fundamental concepts of the computer system with the contemporary skill and knowledge.															
CS 1170.2	To analyse and understand the knowledge of computer equipments both hardware and software, which would leverage the options of employability.															
CS 1170.3	To describe various operating systems, peripheral devices, networking, multimedia and internet.															
CS 1170.4	Demonstrate and understand the terms and various functions associated with hardware and software program menus of computer systems, amalgamation of which would help a student in enhancing entrepreneurship skills.															

0- No Attainment; 1- Low Attainment; 2- Moderate Attainment; 3- Substantial Attainment



Faculty of Science

School of Basic Sciences

Department of Chemistry Course Hand-out

Environmental Science CY 1003 | 3 Credits | 3 0 0 3

Session: July 19 – Nov 19 | Faculty: Naveen Kumar Singh | Class: B.Com. Hons/Pass| Semester I

- A. Introduction: This course is offered by Dept. of Chemistry as a Compulsory Course, targeting students who are studying in undergraduate courses of higher education of all branches including Science, Arts, Social Sciences, Design, Business and Commerce, Journalism and Mass Communication. Offers the knowledge of how natural world works, Environmental and natural processes which effects humans and how human activities and developmental processes change the environment and natural systems. Conservation of nature and natural resources, ecosytems and their services, biodiversity loss and its conservation, environmental pollution, effects and control, environmental policies and practices, human communities and the environment. Students are expected to have basic knowledge of science and social sciences for a better learning.
- **B. Course Outcomes:** At the end of the course, students will be able to

[1003.1] Acquire awareness and sensitivity to environmental and its allied problems.

[1003.2] Acquire skills for identifying and solving environmental problems.

[1003.3] Find out the environmental problems concerning with human activities and developmental processes.

[1003.4] Understand the strategies for conservation of nature and natural resources and to solve the emerging problems related to environment degradation.

[1003.5] Understand physical and chemical processes required for environmental sustainability.

[1003.6] Understand chemical processes for waste management and environmental conservation.

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

[POI]. Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.

[PO2]. Effective Communication: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.

[PO3]. Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.

[PO4]. Effective Citizenship: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

[PO5]. Ethics: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.

[PO6]. Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.

[PO7]. Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context socio technological changes.

[PSO.I]: To Recognize and apply the fundamental concepts of chemistry and their applications.

[PSO.2]: To Employ critical thinking and scientific inquiry in the interpretation of theoretical knowledge at a level suitable to succeed at an entry-level position in chemical industry or a post graduate chemistry program.

[PSO.3]: Understand the applications of chemical sciences in the areas of organic synthesis, synthesis of materials, corrosion inhibition, environment sustainability etc.

D. Assessment Plan:

Criteria	Description	Maximum Marks						
	Sessional Exam I (Closed Book)	20						
Internal Assessment	Sessional Exam II (Closed Book)	20						
(Summative)	In class Quizzes and Assignments ,	10						
	Activity feedbacks (Accumulated and							
	Averaged)							
End Term Exam	End Term Exam (Closed Book)	50						
(Summative)								
	Total	100						
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be							
(Formative)	qualified for taking up the End Semester examination. The allowance of 25%							
	includes all types of leaves including medi	cal leaves.						
Make up Assignments	Students who misses a class will have to	report to the teacher about the absence.						
(Formative)	A makeup assignment on the topic taught	on the day of absence will be given which						
	has to be submitted within a week from t	he date of absence. No extensions will be						
	given on this. The attendance for that p	particular day of absence will be marked						
	blank, so that the student is not accoun	ted for absence. These assignments are						
	limited to a maximum of 5 throughout th	e entire semester.						
Homework/ Home	There are situations where a student may	<i>i</i> have to work in home, especially before						
Assignment/ Activity	a flipped classroom. Although these work	is are not graded with marks. However, a						
Assignment	student is expected to participate and per	form these assignments with full zeal since						
(Formative)	the activity/ flipped classroom participatio	n by a student will be assessed and marks						
	will be awarded.							

E. SYLLABUS

INTRODUCTION Multidisciplinary Nature of Environmental Studies, Scope and importance, concept of sustainability and sustainable development ECOSYSTEMS Concept, structure and function, energy flow in an ecosystem, food chain, food webs and ecological succession, examples. NATURAL RESOURCES (RENEWABLE & NON **RENEWABLE RESOURCES)** Land Resources and land use change, Land degradation, soil erosion and desertification; Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations. Water: Use and over-exploitation of surface and ground water, floods, droughts, conflicts over water (international & inter-state). Energy resources: Renewable and non- renewable energy sources, use of alternate energy sources, growing energy needs, case studies **BIODIVERSITY AND CONSERVATION** Levels, Biogeographic zones Biodiversity patterns and hot spots, India as a mega-biodiversity nation; Endangered and endemic species, threats, conservation, biodiversity services ENVIRONMENTAL POLLUTION type, causes, effects, and controls of Air, Water, Soil and Noise pollution, Nuclear hazards and human health risks, ill effects of fireworks, Solid waste management, case studies ENVIRONMENTAL POLICIES & PRACTICES Climate change, global warming, ozone layer depletion, acid rain, Environment laws, International agreements, nature reserves, tribal populations and rights, and human wildlife conflicts in Indian context HUMAN COMMUNITIES AND THE ENVIRONMENT Human population growth, human health and welfare, Resettlement and rehabilitation, case studies, Disaster management, Environmental ethics, Environmental communication and public awareness, case studies, Field work and visit.

F. TEXT BOOKS

TI. Rajagopalan, R., Environmental Studies: From Crisis to Cure, Oxford University Press, 2016.

T2. De, A. K. Environmental Studies, New Age International Publishers, New Delhi, 2007.

T3. Bharucha, E., Text book of Environmental Studies for undergraduate courses, Universities Press, Hyderabad, 2nd Edition, 2013.

G. REFERENCE BOOKS

RI. Gadgil, M., & Guha, R. This Fissured Land: An Ecological History of India. Univ. of California, Press, 1993.

R2. Carson, R. Silent Spring. Houghton Mifflin Harcourt, 2002.

R3. Groom, Martha J., Gary, K. Meffe, and Carl Ronald Carroll. *Principles of Conservation Biology*. Sunderland: Sinauer Associates, 2006.

R4. Singh, J.S., Singh, S.P., Gupta, S.R. Ecology, Environmental Science and conservation. S. Chand Publishing, New Delhi, 2014.

R5. Sodhi, N.S., Gibson, L. & Raven, P.H. (eds). Conservation Biology: Voices from the Tropics. John Wiley & Sons, 2013.

H. Lecture Plan:

Lec No	Topics	Session Outcome	Mode of Delivery	Corresponding	Mode of	Assessing	the
				СО	Outcome		
	Introduction to Environmental Studies:	Explain about environment and its	Lecture	1003.1	In Class Quiz		
	multidisciplinary nature of environmental	processes and to interpret as			Mid Term I		
	studios	multidisciplinary subject			End Term		
					N 41 1		
2	Scope and importance, concept of	Recall concept of sustainability,	Lecture	1003.1	Mid Term I		
	sustainability and sustainable development	Explain sustainable development,			End lerm		
		Scope and importance of					
		environmental science					
3,4	Ecosystem: concept, structure and function,	Explain ecosystem with structure,	Lecture	1003.1	In Class Quiz		
	Energy flow in an ecosystem, food chain,	flow of energy, nutrients cycling in			Mid Term I		
	food webs	the ecosystem, food chain and food			End Term		
		webs					
5,6	Forest ecosystem, Grassland ecosystem,	Explain different type ecosystem	Lecture	1003.1	In Class Quiz		
	Desert ecosystem, Aquatic ecosystem	with examples of terrestrial and			Mid Term I		
	(Ponds Streams Lakes River Oceans	aquatic ecosystem and their			End Term		
	(Fonds, Scheans, Lakes, Aiver, Occans,	importance					
	Estuaries)						
7.8	Ecological succession, Natural Resources	Recall Ecological succession and its	Lecture	1003.1	In Class Quiz		
	(Renewable & Non Renewable Resources):	type, Explain different Natural			Mid Term I		
	Land Resources and land use change. Land	Resources including Land			End lerm		
	degradation	Resources and land use change					
			1	1002.0			
9	Soil erosion and desertification	Recall soil degradation by erosion	Lecture	1003.2			
		and desertification	1	1002.0	End Term		
10	Deforestation: Causes and impacts due to	Recall Deforestation processes and	Lecture	1003.2			
	mining, dam building on environment,	their impact on the environment and			End Term		
	forests, biodiversity and tribal populations	biodiversity					
	Water: Use and over-exploitation of surface	Recall distribution and consumption	Lecture	1003.2	Mid Term I		
	and ground water floods droughts conflicts	pattern of water across the world			End Term		
	and ground water, noods, droughts, connects	and its related environmental issues					
	over water (international & inter-state).	including overexploitation and					
		conflicts					

12	Energy resources: Renewable and Non-	Recall different Energy resources	Lecture	1003.2	Mid Term I
	renewable energy sources	including coal, oil, nuclear and their			End Term
		environmental impacts on the			
		environment and on human health			
13	Use of alternate energy sources	Explain other energy resources	Lecture	1003.2	Mid Term I
	6/	including solar, water, wind,			End Term
		geothermal and hydrogen energy for			
		sustainability.			
14	Growing energy needs, case studies	Recall energy demand and supply in	Lecture	1003.2	Mid Term I
		different sector and their			End Term
		environmental concern			
15,16	Biodiversity and conservation: Levels of	Recall different variety and	Lecture	1003.3	Mid Term II
	, hiological diversity: genetic species and	variability of plants and animals			End Term
	biological diversity. genetic, species and	Explain different type of			
	ecosystem diversity; Biogeographic zones of	biodiversity and Biogeographic			
	India	zones of India			
17	Diadiversity patterns and dehel his diversity	Compare biodiversity at national and	Locturo	1002.2	Mid Torm II
17	Biodiversity patterns and global biodiversity	global lovel and ecological betspets	Lecture	1005.5	End Torm
	hot spots	for their respective biodiversity			End Term
19	India as a more biodiversity nation:	Rocall different more diversity	Locturo	1003.3	Mid Torm II
10	india as a mega-biodiversity flation,	nation including India	Lecture	1005.5	End Torm
	Endangered and endemic species of India	Describe different Endangered and			
		Describe different Endangered and			
		endemic species of India	1 .	1120.2	MIT
19	Threats to biodiversity: Habitat loss,	Explain biodiversity loss and their	Lecture	1120.3	
	poaching of wildlife, man-wildlife conflicts,	reasons, Explain biological invasive			End Term
	biological invasions	species and their impact on			
	6	biodiversity			
20	Ecosystem and biodiversity services:	Explain the goods and services	Lecture	1003.4	Mid Term II
	Ecological, economic, social, ethical,	provided by biodiversity and the			End Term
	aesthetic and informational value	ecosystem			
21	Concernation of biodiversity in site and Fre	Evalain different measures of		1002.4	Mid Town II
21	Conservation of biodiversity: In-situ and Ex-	Explain different measures of	Lecture	1003.4	
	situ	Description of Diodiversity,			
		Description of Inational parks,			
22		within e sanctuaries etc.		1002 5	Mid Town II
22	Environmental pollution: type, causes,	Recail air pollution and their effects	Lecture	1003.5	End Term
	effects, and controls of Air Pollution	and explain different air pollutants			
		and their impacts on environment			
		and numan health			

23	ill effects of fireworks , Controls of Air	Describe harmful impact of	Lecture	1003.5	Mid Term II
	Pollution	fireworks and control methods of			End Term
		air pollutants like ESP, Scrubber			
24	Type, causes, effects of Water Pollution	Describe water pollutants and their	Lecture	1003.5	Mid Term II
		effects, BOD, COD, water quality			End Term
		parameters, DO, TSS			
25	Controls of Water Pollution	Describe conventional and advance	Lecture	1003.5	Mid Term II
		methods for prevention and control			End Term
		of water pollution			
26	Causes, effects of Soil and Noise Pollution,	Explain the Causes, effects of Soil	Lecture	1003.5	Mid Term II
	Nuclear hazards and human health risks	and Noise Pollution, Nuclear			End Term
		hazards and human health risks			
27	Solid waste management: control measures	Describe different type of solid	Lecture	1003.5	Mid Term II
	of urban and industrial waste	waste and their methods of			End Term
		management			
28,29	Pollution case studies, Environmental	Recall of environmental pollution	Lecture	1003.6	Mid Term II
	Policies & Practices: Climate change and	with some case studies, Describe			End Term
	dobal warming International agroements:	sources and effects of greenhouse			
	giobal warming, international agreements.	gases in global warming and climate			
	Kyoto protocols and Convention on	change and their environmental			
	Biological Diversity (CBD)	impact, Explain different treaties for			
		reduction of greenhouse gases and			
		conservation of biodiversity			
30,3 I	Ozone layer depletion, Montreal protocols,	Explain the importance of ozone	Lecture	1003.6	End Term
	Acid rain and impacts on human	layer and causes of its depletion,			
	communities and agriculture	control measures, Describe the			
		Acid Rain with its effects and			
		control		1002 (
32,33	Environment laws; Water (Prevention and	Describe the provision of Water	Lecture	1003.6	End Term
	control of Pollution) Act, Air (Prevention	Act, 1974, Air Act, 1981for			
	and Control of Pollution) Act,	prevention and control of water			
	Environmental Protection Act	and air pollution, Explain EPA, 1986			
24.25				1002 (
34,35	villalite Protection Act, Forest	Describe the provision of vviidlife	Lecture	1003.6	End Term
	Conservation Act; Nature reserves, tribal	Protection Act, Forest			
	populations and rights, and human wildlife	Conservation Act, Explain			
	conflicts in Indian context. Human	Nature reserves, tribal			
	······································	populations and rights, and			
		human wildlife conflicts in Indian			

	communities and the Environment: Human population growth: impact on environment	context, impact of population growth on environment			
36, 37	Human health and welfare, Resettlement and rehabilitation of project affected persons; case studies, Disaster management: flood, earthquake, cyclone and landslides	Explain human health with respect to environment, measures of disaster management, Describe natural disasters and their impact	Lecture	1003.6	End Term
38	Environmental movements: Chipko, Silent valley, Bishnois of Rajasthan,	Describe different movement in Indian continents for conserve environment and their socio- economic importance	Lecture	1003.6	End Term
39, 40	Environmental ethics: Role of Indian and other religions and cultures in environmental conservation. Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi). Revision on Ecosystem and Natural Resources	Describe role of ethics in preservation and conservation of environment, environmental awareness programme, green enrgy concept and revision	Lecture	1003.6	End Term
41-42	Revision on Biodiversity & Conservation, Environment Pollution and Environmental Policies	Revision for preparation for end term exam	Lecture	1003.6	Class quiz End Term

I. Course Articulation Matrix: (Mapping of COs with POs)

со	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES							CORRELATION WITH PROGRAM SPECIFIC OUTCOMES			
		PO I	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO I	PSO 2	PSO 3	
CY 1003.1	Acquire awareness and sensitivity to environmental and its allied problems.		1	3			3	2	1	1	1	
CY 1003.2	Acquire skills for identifying and solving environmental problems.	2		1	I	2	3	2			2	
CY 1003.3	Find out the environmental problems concerning with human activities and developmental processes.		I	2	2		3		2	2		
CY 1003.4	Understand the strategies for conservation of nature and natural resources and to solve the emerging problems related to environment degradation.	3				2	3	3	1	1	I	
CY 1003.5	Understand physical and chemical processes required for environmental sustainability.	3	2	I	I	3	3	2	3	3	I	
CY 1003.6	Understand chemical processes for waste management and environmental conservation.	2	1	2	1	3	3	2	3	1	2	

I- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

School of Basic Sciences

Department of Biosciences Course Hand-out

Cytology| BT 1150 | 3 Credits | 2103

Session: 2019-20 | Faculty: Dr. Nitesh Kumar Poddar | Class: Generic elective (I Sem)

- A. Introduction: This course is offered by Dept. of Biosciences as a core course in B.Sc. (Hons) Biotechnology Programme targeting students who wish to pursue their career in the field of cell biologist and its related clinical field of science. It is an important course which offers exciting possibilities in health care sectors associated with the abnormalities such as cancerous cells, pre-cancerous cells or infectious disease. The cell biology course work provides a basic and comprehensive knowledge in the field of prokaryotic and eukaryotic cell biology. This course has been designed for undergraduate level studies and has been deliberately kept at a basic level which provides an opportunity for the learner to understand the structure and functions of different organelles, origin of cell, cell cycle, cell-cell communication and application of cytology in multidisciplinary science.
- **B. Course Outcomes:** At the end of the course, students will be able to:
 - [BT 1150.1] Recall structure and function of different component of cells
 - [BT 1150.2] Understanding the cell cycle processes in both plant and animal cells.
 - [BT 1150.3] Compare the role of each and every cell organelle of the cell with their functionalities.
 - [BT 1150.4] Analyse different cell signalling pathways with respect to the environmental responses for maintaining cellular homeostasis.
 - [BT 1150.5] Investigate the different karyotyping for chromosomal abnormalities which leads to different cellular diseases.
 - [BT 1150.6] Investigate recent advancements in cell biology research and technologies that has enabled us understanding the different aspects of the cell with deep understanding and increase employability skills.

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

- **[PO.I].** Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational and personal) from different perspectives.
- [PO.2]. Effective Communication: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.
- [PO.3]. Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.
- [PO.4]. Effective Citizenship: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.
- [PO.5]. Ethics: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.



- [PO.6]. Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.
- [PO.7]. Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes.
- **[PSO.1.]** To demonstrate competency in factual content and interpretation of the major biological concept areas of cell and molecular biology, genetics, organismal biology, and evolution and ecology.
- **[PSO.2.]** To demonstrate the ability to identify significant biological research questions, develop research protocols, and properly analyze research questions through the use of the scientific method.
- [PSO.3.] Enhance analytical and quantitative skills and demonstrate an understanding of basic computational and statistical techniques in the field of Biotechnology

D. Assessment Plan:

Criteria	Description	Maximum Marks
	Mid Term Exam I– IA I	20
Internal Assessment	Mid Term Exam 2 - IA 2	20
(IA)	CWS Assessment IA 3	10
	10 marks of IA 3 are awarded based on the various	
	assignments, class tests, seminar presentation etc.	
End Term Exam (EX)	End Term Exam – EX I	50
	Total	100

Note: A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.

E. SYLLABUS

Cell: Introduction and history, cell theory. Type of Cells: Eukaryotic and prokaryotic cells, animal & plant cells. Cell Membrane: Models, structure of cell wall. Cell Organelles: Endoplasmic reticulum, Golgi complex, Mitochondria, Chloroplasts, Ribosome, Liposome, Peroxisomes, Nucleus, lysosomes, Vacuole, Cytosol and Cytoskeleton (Microtubules, Microfilaments and Intermediate filaments). Cell Division: Mitosis & meiosis, cell cycle. Chromosomes: Structure & functions, karyotype, salivary gland and lamp brush chromosomes. Cell signaling.

TEXT BOOKS

1. S.C. Rastogi. Cell Biology, Tata Mc Graw Hill Pub. Co. New Delhi, 2017.

2. P. K. Gupta. A Text Book of Cell and Molecular Biology, Rastogi Publications, Merrut, 2012.

REFERENCE BOOKS

3. B. Alberts, D. Bray, J. Lewis, M. Raff and J.D. Watson. Molecular Biology of the Cell, Garland Publishing Inc. New York, 2017.

4. D. Robertis, Cell and Molecular Biology, Waverly International, New York, 2011.

5. H. Lodish, A. Berk, S.L. Zipursky, P. Matsudiara, D. Baltimore, and J. Darnell, Molecular Cell Biology, WH Freeman & Co., New York, 2013.

LEC NO	TOPICS	Session Outcome	Mode of	Corresponding	Mode of assessing the
			Delivery		
١.	Cell: Introduction and history	Understanding the principle of Cell	Lecture	BT1150.1	MIEI
				B11150.2	
					EIE
2.	Cell theory	Discuss the origin of cell	Lecture	BT1150.1	MTEI
				BT1150.2	Assignment
					ETE
3.	Type of Cells	Explain the types of cells	Lecture	BT 1150.3	MTE I
					Quiz/Test
4.	Tutorial	Recall the origin and basic principle of	Discussion	BT1150.1	Test/Quiz
		cells		BT1150.2	
				BT1150.3	
5.	Eukaryotic and prokaryotic cells	Understanding the evolution of cells and	Lecture	BT1150.3	MTE I
		their types and functions			ETE
6.	Animal & plant cells	Compare and contrast of Animal and	Lecture	BT1150.3	MTE I
	1	plant cells			Quiz/Test
					ETE
7.	Cell Membrane: Models	Discuss the different theories of Cell	Lecture	BT1150.1	MTE I
		membrane		BT1150.2	
8.	Structure of cell wall.	Explain the structure of cell wall	Lecture	BT1150.1	MTE I
		· ·			
9.	Cell Organelles	Discuss the types organelles in	Lecture	BT1150.1	MTE I
	6	different cells		BT1150.2	
10.	Tutorial	Recall the principle of cells membrane	Discussion	BT1150.1	Quiz/Test
		models with their structures	Discussion	BT1150.2	
		models with their structures		BT1150.2	
11	Endonlasmic reticulum Golgi complex	Compare the structure and functions of	Lecture	BT1150.5	MTF I
	Endoplasmie reneurum, Gorgi complex	EB and Golgi complex	Lecture	BT1150.1	FTF
12	Mitashandria Chlananlasta	Compare the structure and functions of	Locturo	BT1150.2	MTEI
12.	Milochondria, Chioropiasis	Mitoshondria and Chloroplasts	Lecture		
		Philochondria and Chioroplasts		DTTISU.2	EIE
13	Pibosome Linosome Perovisomes	Discuss the structure and functions of	Lecture	BT 1150 3	MTEI
15.	Ribbsome, Liposome, refoxisomes	Ribosome Linosome Perovisomes	Lecture		FTF
14	Nucleus Ivrosomes Vacuala	Discuss the structure and functions of	Lecture	BT 1150 3	MTEI
	rucieus, rysosomes, vacuole	Nucleus lussagemes Versels		0.00.0	ETE
	Tutorial	Pocall structure and functions of	Discussion	BT 1150 2	
15.	I ULUI IAI	different engenelles	Discussion		Quiz/Test
		dimerent organelles			

16.	Cytosol and Cytoskeleton	Understanding the principle of cytosol	Lecture	BT1150.1	MTE I
		with the structure and functions of		BT1150.2	ETE
		Cytoskeleton			
17.	Microtubules, Microfilaments and Intermediate	Discuss different types of Cytoskeleton	Lecture	BT1150.1	MTE I
	filaments	with respect to their structure and		BT1150.2	Assignment/Test
		functions		BT 1150.3	ETE
18.	Cell Division: Mitosis	Discuss the principle of Cell division.	Lecture	BT1150.3	MTE I
		Explain the process of Mitosis.		BT1150.4	ETE
19.	Tutorial	Recall the process of cell division	Discussion	BT 1150.3	Quiz/Test
				BT 1150.4	
				BT 1150.5	
20.	Meiosis	Explain the process of Meiosis	Lecture	BT 1150.4	MTE I
				BT 1150.5	ETE
21.	Meiosis	Discuss in details of cell cycle	Lecture	BT 1508.3	MTE 2
				BT 1508.5	ETE
22.	Chromosomes: Structure & functions	Discuss the structure and functions of	Lecture	BT1150.1	MTE 2
		Chromosomes		BT1150.2	ETE
				BT 1150.3	
23.	Karyotype	Discuss the principle of Karyotype	Lecture	BT 1150.4	MTE 2
				BT 1150.5	ETE
				BT 1150.6	
24.	Tutorial	Recall different phases of Cell cycle	Discussion	BT 1150.4	Quiz/Test
				BT 1150.5	
				BT 1150.6	
25.	Salivary gland chromosomes	Discuss the structure and types of	Lecture	BT 1150.3	MTE 2
		Salivary gland chromosomes			ETE
26.	Lamp brush chromosomes	Discuss the structure and types of	Lecture	BT 1150.3	MTE 2
	1	Salivary gland chromosomes		BT 1150.6	ETE
27.	Cell signalling	Explain the process of Cell signalling	Lecture	BT 1150.4	MTE 2
				BT 1150.5	ETE
28.	Cell signalling	Discuss the importance of cell signalling	Lecture	BT 1150.5	Quiz/Test
		in cell-cell communication		BT 1150.6	
29.	Tutorial	Critically evaluate different types of	Discussion	BT 1150.5	Quiz/Test
		processes involve in Cell signalling		BT 1150.6	
Lab	Laboratory: Introduction to lab and lab	Learn about the lab good practices,	Lab Sessions	BT 1150.3	Experimental results
Sessions	environment, Good Laboratory Practices	handling of different instruments etc.		BT 1150.6	lab sessions
	(GLP) Identification of different cells				End Term Practical
	mitosis in onion root tin				Examination
	mitosis in omon root up.				

со	STATEMENT	COI	CORRELATION WITH PROGRAM OUTCOMES CORRELATION WITH PROGRAM SPECIFIC OUTCOMES					I WITH ECIFIC ES			
		PO	PO	PO	PO	PO	PO 6	PO 7	PSO 1	PSO 2	PSO 3
[BT 1150.1]	Recall structure and function of different component of cells	1	2	3	4	5			1		
[BT 1150.2]	Understanding the cell cycle processes both plant and animal cells.		1						1		
[BT 1150.3]	Compare the role of each and every cell organelle of the cell with their functionalities.	1	1						1		
[BT 1150.4]	Analyse different cell signalling pathways with respect to the environmental responses for maintaining cellular homeostasis.	1	1							1	
[BT 1150.5]	Investigate the different karyotyping for chromosomal abnormalities which leads to different cellular diseases			1`		1		1		1	1
[BT 1150.6]	Investigate recent advancements in cell biology research and technologies that has enabled us understanding the different aspects of the cell with deep understanding and increase employability skills.				1	1		2		1	2

I- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation



School of Basic Sciences

Department of Chemistry Course Hand-out

Inorganic Chemistry I | CY1212 | 4 Credits | 3104

Session: Jan. 18 - May 18 | Faculty: Dr. Sriparna Ray | Class: B.Sc. (Chem. Hons.) II Semester

- A. Introduction: This course is offered by Dept. of Chemistry for 2nd Semester B. Sc. (Chemistry Hons.) students. The objective of the course is to acquaint the students with the basic concepts of chemistry of s-block (group 1 and 2, alkali metals and alkali earth metals) and p-block elements (group 13 and group 14) elements. The course also covers about preliminary understanding of ionic compounds and nature of their bonding, structure and number of coordination. A detailed discussion of conductors, insulators, semiconductors is also included on the basis of nature of bonding present in each.
- B. Course Outcomes: At the end of the course, students will be able to

[CY1212.1] Apply current chemistry theories to understand and predict the physical and electronic properties of alkali metals and alkaline earth metals.

[CY1212.2] Develop an understanding of the chemistry of group 13 and group 14 elements.

[CY1212.3] Establish an appreciation of the role of inorganic chemistry in the chemical sciences.

[CY1212.4] Compare difference between ionic and covalent compound in terms of bonding.

[CY1212.5] Provide an understanding of chemical methods employed for problem solving involving inorganic systems.

[CY1212.6] Develop skills related to professional and safety responsibilities required in working with inorganic systems.

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

- [PO.1]. Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives
- [PO.2]. Effective Communication: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, andmake meaning of the world by connecting people, ideas, books, media and technology
- [PO.3]. Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.
- [PO.4]. Effective Citizenship: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.
- [PO.5]. Ethics: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.
- [PO.6]. . Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.
- [PO.7]. Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes.
- [PSO.1]. Recognize and apply the fundamental concepts of chemistry and their applications.

- [PSO.2]. Employ critical thinking and scientific inquiry in the interpretation of theoretical knowledge at a level suitable to succeed at an entry-level position in chemical industry or a post graduate chemistry program.
- [PSO.3]. Understand the applications of chemical sciences in the areas of organic synthesis, synthesis of materials, corrosion inhibition, environment sustainability etc. Apply these principles both in simple exercises and in more complex problems of Chemistry

D. Assessment Plan:

Criteria	Description	Maximum Marks			
	Sessional Exam I	20			
Internal Assessment	Sessional Exam II	20			
(Summative)	In class Quizzes and Assignments , Activity feedbacks (Accumulated and Averaged)	10			
End Term Exam	End Term Exam	50			
(Summative)					
	Total	100			
Attendance (Formative) Make up Assignments (Formative)	A minimum of 75% Attendance is student to be qualified for taking u The allowance of 25% includes all leaves. Students who misses a class will h the absence. A makeup assignment absence will be given which has to the date of absence. No extensis attendance for that particular day of that the student is not accounted for limited to a maximum of 5 through	s required to be maintained by a up the End Semester examination. types of leaves including medical have to report to the teacher about t on the topic taught on the day of be submitted within a week from ons will be given on this. The f absence will be marked blank, so or absence. These assignments are nout the entire semester.			
Homework/ Home Assignment/ Activity Assignment (Formative)	There are situations where a stud especially before a flipped classroo graded with marks. However, a stu perform these assignments with fu classroom participation by a studen be awarded.	lent may have to work in home, om. Although these works are not dent is expected to participate and ull zeal since the activity/ flipped nt will be assessed and marks will			

E. SYLLABUS

Hydrogen: Position in the periodic table, isotopes, industrial production, properties, reactions and isotopes; **The** *s***-block elements:** Production and uses of alkali and alkaline earth metals, chemical reactivity, structure and properties of oxides, halides and hydroxides, coordination complexes; **The** *p***-block elements - I:** Chemical reactivity of B, Al, Ga, In and Tl, compounds of boron and aluminum, chemical reactivity and group trends of C, Si, Ge, Sn and Pb, allotropes of carbon, compounds of Si, Ge, Sn and Pb; **Ionic bond:** Factors affecting the stability of ionic compounds, lattice energy, Born Lande equation and its applications, Madelung constant, Born-Haber cycle, Fazan's rules, ionic radii, factors affecting the radii of ions, Structure of crystal lattices, predictive power of thermochemical

calculations on ionic compounds; **Intermolecular forces and metallic bond:** Van der Waals forces (Keesom, Debye & London Interactions). Structure of metals, valence bond and band model; **Perfect and imperfect crystals**: Intrinsic and extrinsic defects, point defects, line and plane defects, vacancies-Schottky and Frenkel defects. Thermodynamics of Schottky and Frenkel defect, band theory, band structure of metals, insulators and semiconductors, intrinsic and extrinsic semiconductors, doping semiconductors, p-n junctions, High temperature super conductors.

F. TEXT BOOKS

A book or a set of books which covers 60% or more of the syllabus can be written under this category. (Not more than 3)

1. Lee, J. D., Concise Inorganic Chemistry. ELBS Publication, 2010.

2. Malik, W. U., Tuli, R. D. and Madan, G. D. Selected Topics in Inorganic Chemistry, S. Chand group company, 2010.

3. Shriver & Atkins' Inorganic Chemistry, Oxford University Press

G. REFERENCE BOOKS

- 1. Cotton F. A. and Wilkinson, G. Advanced Inorganic Chemistry, John Wiley, 2011.
- 2. Huhey, J. E., Inorganic chemistry: principles of structure and reactivity. Harper and Row, 2010

H. Lecture Plan:

LEC NO	TOPICS
1 - 2	Hydrogen: Position in the periodic table, isotopes, industrial production,
	properties, reactions and isotopes;
3	Question – Answers on Unit -1
4 - 6.	The s-block elements: Production and uses of alkali and alkaline earth metals,
	chemical reactivity,
7	structure and properties of oxides
8	structure and properties of halides
9	structure and properties of hydroxides
10	coordination complexes;
11	Question – Answers on Unit -2
12 - 13	The <i>p</i> -block elements - I: Chemical reactivity of B, compounds of boron
14 - 15	Chemical reactivity of Al, compounds of aluminium
16	Chemical reactivity of Ga, In and Tl
17 - 18	chemical reactivity and group trends of C, Si, Ge, Sn and Pb, allotropes of carbon,
19 - 20	compounds of Si
21 - 22	compounds of Ge, Sn and Pb
23	Question – Answers on Unit -3

24 - 25	Ionic bond: Factors affecting the stability of ionic compounds, lattice energy, Born Lande equation and its applications, Madelung constant, Born-Haber cycle,
26	Fazan's rules,
27	ionic radii, factors affecting the radii of ions
28	Structure of crystal lattices,
29	predictive power of thermochemical calculations on ionic compounds
30	Question – Answers on Unit -4
31 - 32	Intermolecular forces: Van der Waals forces (Keesom, Debye & London Interactions).
33 - 34	Metallic bond: Structure of metals, valence bond and band model;
35	Question – Answers on Unit -5
36 - 37	Perfect and imperfect crystals : Intrinsic and extrinsic defects, point defects, line and plane defects
38 - 40	Vacancies-Schottky and Frenkel defects. Thermodynamics of Schottky and Frenkel defect
41 - 42	band theory, band structure of metals
43	insulators and semiconductors
44	intrinsic and extrinsic semiconductors, doping semiconductors, p-n junctions
45	High temperature super conductors
46	Revision
47	Revision
48	Revision

I. Course Articulation Matrix: (Mapping of COs with POs)

СО	STATEMENT	CORRELATION WITH PROGRAM CORRELATION V OUTCOMES PROGRAM SPEC OUTCOMES					N WITH ECIFIC ES				
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3
[CY1212.1]	Apply current chemistry theories to understand and predict the physical and electronic properties of alkali metals and alkaline earth metals.	3	2	1					3		
[CY1212.2]	Develop an understanding of the chemistry of group 13 and group 14 elements.	2						3	2		
[CY1212.3]	Establish an appreciation of the role of inorganic chemistry in the chemical sciences.							2	1		
[CY1212.4]	Compare difference between ionic and covalent compound in terms of bonding.	2							1		1
[CY1212.5]	Provide an understanding of chemical methods employed for problem solving involving inorganic systems.			1			1			3	
[CY1212.6]	Develop understanding of the professional and safety responsibilities residing in working with inorganic systems.			2	2		2			2	3

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

J. Course Outcome Attainment Level Matrix:

со	STATEMENT	ATT	ATTAINMENT OF PROGRAM OUTCOMES THRESHOLD VALUE: 40%						ATTAINMENT OF PROGRAM SPECIFIC OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3
[CY1212.1]	Apply current chemistry theories to understand and predict the physical and electronic properties of alkali metals and alkaline earth metals.	3.00	2.00	2.00					3.00		
[CY1212.2]	Develop an understanding of the chemistry of group 13 and group 14 elements.	1.00						1.00	1.00		
[CY1212.3]	Establish an appreciation of the role of inorganic chemistry in the chemical sciences.							1.00	1.00		
[CY1212.4]	Compare difference between ionic and covalent compound in terms of bonding.	2.00							2.00		2.00
[CY1212.5]	Provide an understanding of chemical methods employed for problem solving involving inorganic systems.		0.67	0.67	0.67	0.00	1.00	1.00	1.00	1.00	1.00
[CY1212.6]	Develop understanding of the professional and safety responsibilities residing in working with inorganic systems.			1.33	1.33					2.00	2.00

0-No Attainment; 1- Low Attainment; 2- Moderate Attainment; 3- Substantial Attainment



School of Basic Science

Department of Chemistry Course Hand-out

Organic Chemistry-II | CY 1213 | 4 Credits | 3 1 0 4

Session: Jan 18 – May 18 | Faculty: Dr Meenakshi Pilania | Class: Core subject, BSc (Hons, IIst semester)

- A. Introduction: This course is offered by Department of Chemistry as a core subject. This course introduces the students to basic fundamentals and topics relevant to the field of organic chemistry. Organic chemistry course help students to become familiar with various hydrocarbon (alkenes, cycloalkenes, dienes and alkynes) and the concept of aromaticity. This course offers in depth knowledge of organic reaction mechanism including electrophilic aromatic substitution reactions and effect of activating and deactivating group on benzene ring. The aim of this course is to provide information about various moieties with different functional group such as alkyl halides, alcohol, phenol, ether and epoxides.
- **B. Course Outcomes:** At the end of the course, students will be able to
 - **[1213.1].** Understand the synthesis and chemical reactivity of various hydrocarbon including alkenes, cycloalkenes, dienes and alkynes.
 - [1213.2]. Complete understanding the concept of aromaticity based on Huckel rule and frost cycle, also able to explain Kekule's structures and MOT for benzene.
 - [1213.3]. Recognize to write the mechanism of electrophilic aromatic substitution reactions and effect of activating and deactivating group on benzene ring.
 - [1213.4]. Detailed study of various functional group attached to the aliphatic and aromatic system such alkyl and aryl halides, alcohol and phenol.
 - [1213.5]. To explain the synthesis and reactivity of ether and cyclic ether (epoxides).

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

- [PO.1]. Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.
- [PO.2]. Effective Communication: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.
- [PO.3]. Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.
- [PO.4]. Effective Citizenship: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.
- [PO.5]. Ethics: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.
- [PO.6]. Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.

[PO.7]. Environment and Sustainability: Understand the issues of environmental contexts and sustainable development. Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes.

[PSO.1]. Recognize and apply the fundamental concepts of chemistry and their applications.

[PSO.2]. Employ critical thinking and scientific inquiry in the interpretation of theoretical knowledge at a level suitable to succeed at an entry-level position in chemical industry or a post graduate chemistry program.

[PSO.3]. Understand the applications of chemical sciences in the areas of organic synthesis, synthesis of materials, corrosion inhibition, environment sustainability etc.

D. Assessment Plan:

Criteria	Description	Maximum Marks
	Sessional Exam I (Closed Book)	20
Internal Assessment	Sessional Exam II (Closed Book)	20
(Summative)	Assignments , Activity feedbacks	10
	(Accumulated and Averaged)	
End Term Exam	End Term Exam (Closed Book)	50
(Summative)		
	Total	100
Attendance	A minimum of 75% Attendance is requi	red to be maintained by a student to be
(Formative)	qualified for taking up the End Semest	er examination. The allowance of 25%
	includes all types of leaves including medi	cal leaves.
Make up Assignments	Students who misses a class will have to	report to the teacher about the absence.
(Formative)	A makeup assignment on the topic taught	on the day of absence will be given which
	has to be submitted within a week from t	he date of absence. No extensions will be
	given on this. The attendance for that p	particular day of absence will be marked
	blank, so that the student is not accour	ted for absence. These assignments are
	limited to a maximum of 5 throughout th	e entire semester.
Homework/ Home Assignment/	There are situations where a student may	<i>i</i> have to work in home, especially before
Activity Assignment	a flipped classroom. Although these work	is are not graded with marks. However, a
(Formative)	student is expected to participate and per	form these assignments with full zeal since
	the activity/ flipped classroom participation	n by a student will be assessed and marks
	will be awarded.	

E. SYLLABUS

Alkenes, Cycloalkenes, Dienes and Alkynes: Nomenclature, synthesis and reactions of alkenes, cycloalkenes, dienes and alkynes. Arenes and Aromaticity: Nomenclature of benzene and derivatives, Kekule structure, carbon-carbon bond lengths of benzene, resonance structure, MO picture, Aromatic electrophilic substitution, activating and deactivating substituents, orientation and ortho/para ratio; Alkyl and Aryl Halides: Nomenclature and classes of alkyl halides, methods of formation, chemical reactions and mechanisms; Alcohols: Classification and nomenclature of monohydric, dihydric and trihydric alcohols, methods of formation and reactions of alcohols; Phenols: Nomenclature, structure and bonding of phenols, synthesis and reactions of phenols, physical properties and acidic character; Ethers and Epoxides: Nomenclature of ethers and methods of their preparation, physical properties, chemical reactions, cleavage and autoxidation, synthesis of epoxides, acid and basecatalyzed ring opening of epoxides.

F. TEXT BOOKS

- 1. R. T. Morrison, R. N. Boyd and S. K. Bhattacharjee, Organic Chemistry, Pearson India, 2011.
- 2. T. W. G. Solomons and C. B. Fryhle, *Organic Chemistry*, Wiley India, 2012.
- 3. P. Sykes, A Guidebook to Mechanism in Organic Chemistry, Pearson India, 2003.
- 4. I.L. Finer, Organic Chemistry, Volume I, Pearson India, 2002.
- 5. I.L. Finer, Organic Chemistry, Volume II, Pearson India, 2002.

G. REFERENCE BOOKS

- 1. F. A. Carey and R. J. Sundberg, Advanced Organic Chemistry: Structure And Mechanisms (Part A), Springer India Private Limited, 2007.
- 2. F. A. Carey and R. J. Sundberg, *Advanced Organic Chemistry: Reaction And Synthesis (Part B)*, Springer India Private Limited, 2007.
- 3. M. B. Smith, J. March, March's Advanced Organic Chemistry: Reactions, Mechanisms and Structure, Wiley India, 2012.

H. Lecture Plan:

LEC NO	TOPICS
1	Introduction and Course Hand-out briefing
2,3	Nomenclature and synthesis of alkene
4,5	Physical and chemical reactivity of alkene
6	Stability of alkene, heat of hydrogenation
7,8	Nomenclature, synthesis and chemical reactivity of cycloalkene
9,10	Nomenclature, method of preparation of diene, physical and chemical reactivity of diene
10,11	Nomenclature, synthesis and chemical reactivity of alkynes
12,13	Aromaticity: General Introduction, Kekule structure, huckel-Mobius rule
14,15	Nomenclature of benzene and derivatives, Frost diagram
16	Carbon-carbon bond lengths of benzene, resonance structure, MO picture of benzene
17,18	General introduction of aromatic electrophilic substitution reaction
19,20,21	Aromatic electrophilic substitution reaction in various aromatic compounds like pyrrole, furan,
	pyridine, thiophene
22,23	Activating and deactivating substituents, orientation and ortho/para ratio
24	General introduction of Alkyl and Aryl Halides
25,26	Synthesis and chemical reactivity of alkyl halide
27	Overall reactivity order of substituents towards nucleophilic substitution reactions For both SN1 and SN2
28,29	Synthesis, nomenclature, electrophilic substitution reaction in aryl halide
30,31	Alcohols: Classification, nomenclature, method of preparation and chemical reactivity
	of monohydric
32,33	Classification, nomenclature, method of preparation and chemical reactivity of dihydric
34,35,36	Classification, nomenclature, method of preparation and chemical reactivity of trihydric
37,38	Phenol: General introduction, Nomenclature, structure and bonding of phenols
39,40	Synthesis and reactions of phenols
41, 42	Physical properties and acidic character of Phenol
43,44,45	Name reaction of Phenol with mechanism
46	Ethers and Epoxides : A general introduction
47,48	Nomenclature of ethers and methods of their preparation
49,50	Physical properties, chemical reactions of ether
51	Cleavage and autoxidation of ether
52	Synthesis of epoxides and chemical reactivity of epoxide
53	Acid catalyzed ring opening of epoxides.
54	Base catalyzed ring opening of epoxides.
55-57	Conclusion and Course Summarization

I. Course Articulation Matrix: (Mapping of COs with POs)

		CORRELATION WITH PROGRAM OUTCOMES						CORRELATION WITH PROGRAM			
со	STATEMENT								SPECIFIC OUTCOMES		
	STATEMENT	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3
CY1213.1	Develop the skills to understand the reactivity of various hydrocarbon including alkenes, cycloalkenes, dienes and alkynes.	2	1				2	2	2	3	2
CY1213.2	Complete understanding the concept of aromaticity based on Huckel rule and frost cycle, also able to explain Kekule's structures and MOT for benzene.	3	1				1	1	2	2	1
CY1213.3	Recognize to write the mechanism of electrophilic aromatic substitution reactions and effect of activating and deactivating group on benzene ring.	3	1				1	2	3	1	3
CY1213.4	Detailed study of various functional group attached to the aliphatic and aromatic system such alkyl and aryl halides, alcohol and phenol.	2	1				1	1	2	1	3
CY1213.5	To explain the synthesis and reactivity of ether and cyclic ether (epoxides).	3	1				1	1	1	1	3

I- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

со	STATEMENT	ATTAINMENT OF PROGRAM OUTCOMES THRESHOLD VALUE: 35%								ATTAINMENT OF PROGRAM SPECIFIC OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3	
CY1213.1	Understand the synthesis and chemical reactivity of various hydrocarbon including alkenes, cycloalkenes, dienes and alkynes.	1.00	0.33				0.67	0.67	1.00	1.00	1.00	
CY1213.2	Complete understanding the concept of aromaticity based on Huckel rule and frost cycle, also able to explain Kekule's structures and MOT for benzene.	1.00	0.33				0.67	0.67	1.00	1.00	1.00	
CY1213.3	Recognize to write the mechanism of electrophilic aromatic substitution reactions and effect of activating and deactivating group on benzene ring.	1.00	0.33				0.67	0.67	1.00	1.00	1.00	
CY1213.4	Detailed study of various functional group attached to the aliphatic and aromatic system such alkyl and aryl halides, alcohol and phenol.	0.00	0.00				0.00	0.00	0.00	0.00	0.00	
CY1213.5	To explain the synthesis and reactivity of ether and cyclic ether (epoxides).	2.00	0.67	0.00	0.00	0.00	1.33	1.33	2.00	2.00	2.00	

0-No Attainment; I- Low Attainment; 2- Moderate Attainment; 3- Substantial Attainment



School of Basic Sciences

Department of Chemistry Course Hand-out

Physical Chemistry-II | CY 1214 | 4 Credits | 3 | 0 4

Session: Jan 18 - May 18 | Faculty: Dr. Debasis Behera | Class: B.Sc. (Hons.), II semester

A. Introduction: This course is offered by Dept. of Chemistry to undergraduate students for the B.Sc. (Hons.) II sem programme, targeting students who wish to pursue masters or higher studies & research in the field of physical chemistry with specific focus on the interdisciplinary nature. The course offers in depth knowledge of equilibrium, Partial molar properties, concept of chemical potential application of free energy and its applications in mixture of binary solutions. Coupled reaction in biochemical process, dilute solutions, colligative properties, physical Transformation of Pure Materials and introduction of electrochemical cells. Students are expected to have background knowledge in physical chemistry and mathematics up to the undergraduate level for this course.

B. Course Outcomes: At the end of the course, students will be able to

[1214.1]. Acquire a strong foundations of partial molar properties, fugacity of real gases, chemical potential and its variation with temp and pressure for different systems; application to study the thermodynamics of simple mixtures.

[1214.2]. Establish the phase rule for one, two component systems, eutectics; and its thermodynamic derivation; fundamentals of physical transformation of pure materials.

[1214.3]. Inculcate firm foundations in the fundamentals and application of chemical equilibrium, and free energy. And able to derive the relationship between different equilibrium constants.

[1214.4]. Derive thermodynamics of Electrolytic Solutions, and interpret Debye-Huckel theory, ionic strength, mean ionic activity coefficient and the Debye-Huckel limiting law for activity coefficients.

[1214.5]. Understand the basic concept of Solutions of non-volatile solutes, colligative properties, able to Molecular weights from various colligative properties.

[1214.6]. Develop skill to solve problems on Electrochemical Cells, electrode potentials, emf & solubility product measurements, potentiometric titrations, pK and pH measurements.

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

- **[PO.1].** Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.
- **[PO.2].** Effective Communication: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.
- **[PO.3].** Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.
- **[PO.4].** Effective Citizenship: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.
- **[PO.5].** Ethics: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.
- **[PO.6].** Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.
- **[PO.7].** Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes

[PSO.I]. Recognize and apply the fundamental concepts of chemistry and their applications.

[PSO.2]. Employ critical thinking and scientific inquiry in the interpretation of theoretical knowledge at a level suitable to succeed at an entry-level position in chemical industry or a post graduate chemistry program.

[PSO.3]. Understand the applications of chemical sciences in the areas of organic synthesis, synthesis of materials, corrosion inhibition, environment sustainability etc.

D. Assessment Plan:

Criteria	Description	Maximum Marks					
	Sessional Exam I	20					
Internal Assessment	Sessional Exam II	20					
(Summative)	In class Quizzes and Assignments ,	10					
	Activity feedbacks (Accumulated and						
	Averaged)						
End Term Exam	End Term Exam	50					
(Summative)							
	Total	100					
Attendance	A minimum of 75% Attendance is required to be maintained by a student to b						
(Formative)	qualified for taking up the End Semester examination. The allowance of 25						
	includes all types of leaves including medical leaves.						
Make up Assignments	Students who misses a class will have to report to the teacher about the absence.						
(Formative)	A makeup assignment on the topic taught on the day of absence will be given which						
	has to be submitted within a week from the date of absence. No extensions will be						
	given on this. The attendance for that particular day of absence will be marked						
	blank, so that the student is not accounted for absence. These assignments are						
	limited to a maximum of 5 throughout the entire semester.						
Homework/ Home Assignment/	There are situations where a student may have to work in home, especially before						
Activity Assignment	a flipped classroom. Although these works are not graded with marks. However, a						
(Formative)	student is expected to participate and perform these assignments with full zeal sinc						
	the activity/ flipped classroom participation by a student will be assessed and ma will be awarded.						

E. SYLLABUS

Partial Molar Properties and Fugacity: Partial molar properties, chemical potential of a perfect gas, dependence of chemical potential on temperature and pressure, Gibbs-Duhem equation, real gases, fugacity, Clausius Clapeyron equation and its application to solid-liquid, liquid-vapour and solid-vapour equilibria; Thermodynamics of Simple Mixtures: Thermodynamic functions for mixing of perfect gases, chemical potential of liquids. Raoult's law, Henry's law; Physical Transformation of Pure Materials: First and second order phase transitions, attainment of low temperature and energetics of refrigeration, adiabatic demagnetization; Phase Equilibria: Phase rule and its thermodynamic derivation, one component systems, two component systems, eutectics, freezing mixtures, ultra purity, zone refining; Chemical Equilibrium: Direction of spontaneous change in a chemical reaction, extent of reaction, stoichiometric coefficients, equilibrium constant in terms of G. temperature and pressure dependence of equilibrium constant, homogeneous and heterogeneous equilibria; Thermodynamics of Electrolytic Solutions: Activities of ions in solutions, model of ions in a solution, qualitative idea of Debye-Huckel theory, ionic strength, mean ionic activity coefficient and the Debye-Huckel limiting law for activity coefficients; Colligative Properties: Solutions of non-volatile solutes, colligative properties, elevation in boiling point, depression in freezing point, osmosis and osmotic pressure; Electrochemical Cells: Interfacial potential difference, the electrodes, potential at interfaces, electrode potentials, galvanic cells, emf, direction of spontaneous reactions, measurements of solubility product, potentiometric titrations, pK and pH measurements.

F. TEXT BOOKS

- I. P. Atkins and J. depaula, Atkins's Physical Chemistry, Oxford University Press, NY, 2004.
- 2. B.R. Puri, L.R. Sharma and M.S. Pathania, Principal of Physical Chemistry, Vishal Publication Jalandhar, 2010.
- 3. K. L. Kapoor, A Text Book of Physical Chemistry, Vol-1-6, Macmillan Publishers India, 2010.
- 4. K. J. Laidler, Chemical Kinetics, Pearson publication, 2010.
G. **REFERENCE BOOKS**

- R. G.M. Barrow, Physical Chemistry (special Indian Edition), Tata Mcgraw Hill Education Private Limited.
 D.A. McQuarria and J. D. Simon, Physical Chemistry: A molecular Approach, Viva books.
- 3. Ira N. Levine, Physical Chemistry, Tata McGraw Hill, 2007.

Н. Lecture Plan:

Lecture No.	Topics
	Partial Molar Properties and Fugacity: Partial molar properties, derivations and
	applications.
2	chemical potential of a perfect gas
3	Dependence of chemical potential on temperature and pressure, and its application.
4	Gibbs-Duhem equation: derivation and numerical problems
5	Real gases, fugacity (thermodynamic treatment of ideal and real gases and their deviations.
6	Clausius Clapeyron equation and its application to solid-liquid, liquid-vapour and solid- vapour equilibria
7	Thermodynamics of Simple Mixtures: Introduction of mixtures, (ideal and non-ideal mixtures)
8	Thermodynamic functions for mixing of perfect gases,
9	chemical potential of liquids,
10	Raoult's law, Henry's law and their applications
11	Physical Transformation of Pure Materials: First and second order phase transitions,
12	attainment of low temperature and energetics of refrigeration,
13	adiabatic demagnetization;
14	Phase Equilibria: Phase rule and its importance
15	and its thermodynamic derivation, one component systems,
16	two component systems, eutectics, Pb-Ag phase diagrame
17	freezing mixtures, ultra purity, zone refining;
18	Chemical Equilibrium: Direction of spontaneous change in a chemical reaction,
19	extent of reaction, stoichiometric coefficients,
20	equilibrium constant in terms of G.
21	temperature and pressure dependence of equilibrium constant,
22	homogeneous and heterogeneous equilibria
23	Thermodynamics of Electrolytic Solutions: Activities of ions in solutions,
24	model of ions in a solution,
25	qualitative idea of Debye-Huckel theory, derivations, factor influencing Debye-Huckel theory (electrophoretic effect, assymetric effect, viscous effect)
26	ionic strength, mean ionic activity coefficient
27	The Debye-Huckel limiting law for activity coefficients;

28	Colligative Properties: Solutions of non-volatile solutes,
29	colligative properties, elevation in boiling point, depression in freezing point, osmosis
30	Numerical problems associated with depression of freezing point and elevation of boiling point
31	osmotic pressure, mechanism of reverse osmosis and its practical application
32	Electrochemical Cells: Interfacial potential difference,
33	the electrodes, potential at interfaces,
34	electrode potentials, galvanic cells,
35	emf, direction of spontaneous reactions,
36	measurements of solubility product,
37	potentiometric titrations,
38	pK and pH measurements.
39	Numerical problems of EMF measurements and spontaneity of electrochemical cell.
40	Revision class and numerical problems
41	Class test
42	Revision of Partial Molar Properties and Fugacity
43	Revision of Thermodynamics of Simple Mixtures
44	Revision of Physical Transformation of Pure Materials and phase equilibria
45	Revision of Electrochemistry

со	STATEMENT		CORRELATION WITH PROGRAM OUTCOMES						CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3
CY 1214.1	Acquire a strong foundations of partial molar properties, fugacity, chemical potential and its application in thermodynamics of simple mixtures.	2			3	3				2	3
CY 1214.2	Establish the phase rule for one, two component systems, eutectics; and its thermodynamic derivation; fundamentals of physical transformation of pure materials.	3		3			3		3		3
CY 1214.3	Inculcate firm foundations in the fundamentals and application of chemical equilibrium, and free energy.		3					3		3	
CY 1214.4	Derive thermodynamics of Electrolytic Solutions, and interpret Debye-Huckel theory, ionic strength, mean ionic activity coefficient and the Debye-Huckel limiting law for activity coefficients.			3		3		2			3
CY 1214.5	Understand the basic concept of Solutions of non-volatile solutes, colligative properties, able to Molecular weights from various colligative properties.	3			2					2	
CY 1214.6	Develop skill to solve problems on Electrochemical Cells, electrode potentials, emf & solubility product measurements, potentiometric titrations, pK and pH measurements.		2				2		3		3

I- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

2. Course Outcome Attainment Level Matrix:

со	STATEMENT		ATTAINMENT OF PROGRAM OUTCOMES THRESHOLD VALUE: 40%						ATTAINMENT OF PROGRAM SPECIFIC OUTCOMES							
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
AU 1492.1	Course Outcome statement															
AU 1492.2	Course Outcome statement															
AU 1492.3	Course Outcome statement															
AU 1492.4	Course Outcome statement															
AU 1492.5	Course Outcome statement															

0-No Attainment; I- Low Attainment; 2- Moderate Attainment; 3- Substantial Attainment



School of Computing and Information Technology

Department of Mathematics & Statistics Course Hand-out

Discrete Mathematics | MA 1212 | 4 Credits | 3 1 0 4

Session: July 18 – Dec. 18 | Faculty: Dr. Ram Naresh Saraswat/Dr Anamika Jain | Class: Regular

- A. Introduction: This course is offered by Dept. of Mathematics & Statistics as a regular course, targeting students who wish to pursue B.Sc. (Hons) Chemistry. It offers in depth knowledge of sets, relations, functions, Basic counting techniques, propositional and predicate and propositional logic, basic/introductory level graph theory. Students are expected to have background knowledge on number system.
- **B. Course Outcomes:** At the end of the course, students will be able to
 - [1212.1]. Apply the operations of sets, find the partition for a set through equivalence classes
 - [1212.2]. Express a logic sentence in terms of predicates, quantifiers, and logical connectives
 - [1212.3]. Demonstrate an understanding of relations and functions and be able to determine their properties and also determine when a function is 1-1 and "onto".
 - **[1212.4]**. Solve counting problems by applying elementary counting techniques using the product and sum rule, model a recurrent relation and finding solution to the problem by solving recurrence relation
 - [1212.5]. Use tree and graph algorithms to solve problems and applications to develop skills.

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

- [PO.1]. Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.
- [PO.2]. Effective Communication: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.
- [PO.3]. Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.
- [PO.4]. Effective Citizenship: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.
- [PO.5]. Ethics: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.
- [PO.6]. Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.
- [PO.7]. Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes
- [PSO.1] To understand the basic principles and apply these principles both in simple exercises and in more complex problems of advanced study.
- [PSO2] To Understand and apply the fundamental concepts of Sciences, employ critical thinking and scientific queries at a suitable level to get success in Professional domain and / or Higher Studies.
- [PSO.3] To understand the Mathematical applications in science & Technology.

D. Assessment Plan:

Criteria	Description	Maximum Marks				
	Sessional Exam I (Closed Book)	20				
Internal Assessment	Sessional Exam II (Closed Book)	20				
(Summative)	In class Quizzes and Assignments ,	10				
	Activity feedbacks (Accumulated and					
	Averaged)					
End Term Exam	End Term Exam (Closed Book)	50				
(Summative)						
	Total	100				
Attendance	A minimum of 75% Attendance is requi	red to be maintained by a student to be				
(Formative)	qualified for taking up the End Semester examination. The allowance of 25%					
	includes all types of leaves including medi	cal leaves.				
Make up Assignments	Students who misses a class will have to	report to the teacher about the absence.				
(Formative)	A makeup assignment on the topic taught	on the day of absence will be given which				
	has to be submitted within a week from t	he date of absence. No extensions will be				
	given on this. The attendance for that p	particular day of absence will be marked				
	blank, so that the student is not accour	nted for absence. These assignments are				
	limited to a maximum of 5 throughout th	e entire semester.				
Homework/ Home Assignment/	There are situations where a student may	have to work in home, especially before				
Activity Assignment	a flipped classroom. Although these work	s are not graded with marks. However, a				
(Formative)	student is expected to participate and per	form these assignments with full zeal since				
	the activity/ flipped classroom participatic	on by a student will be assessed and marks				
	will be awarded.					

E. SYLLABUS

Set Theory: Types of relations on sets and their properties, Relational matrix and the graph of a relation, Partitions, Equivalence relations, Poset, Hasse diagram. Definitions & Classification of functions, Characteristic function of a set, Hashing functions, Recursive functions, Permutation functions. Combinatorics: Discrete numeric function, Basic counting principles, Generating functions, Recurrence relations, Inclusion and exclusion principle, Euler's \$\overline{0}\$ function and its applications to Cryptography. Propositional Calculus: Logical connectives, Truth tables, Tautologies and contradictions, Contrapositive, Logical equivalences and implications, De Morgan's Laws, Normal forms, Rules of inference, Arguments, Validity of arguments. Predicate Calculus: Free and bound variables, Quantifiers, Theory of inference, the rules of universal specification and generalization, Validity of arguments. Graph Theory: Definition and examples of graphs, Incidence and degree, Handshaking lemma, Isomorphism Sub-graphs, Weighted Graphs, Walks, Paths and Circuits, Eulerian Graphs, Hamiltonian Graphs. Trees: Definition and properties of trees, pendent vertices, center of a tree, rooted and binary tree, spanning tree, minimum spanning tree algorithms, fundamental circuits, cut-sets and cut vertices, fundamental cut-sets, the four color theorem. Directed Graphs: Types of digraphs, directed paths and connectedness, Directed trees.

F. TEXT BOOKS

- 1. R. P. Grimaldi, Discrete and Combinatorial Mathematics: An Applied Introduction, Fourth Edition, Pearson Education Asia, 2002.
- 2. T. Veerarajan, Discrete Mathematics, Tata McGraw Hill, 2010.
- 3. S. K. Chakraborty, B. K. Sarkar, Discrete Mathematics, Oxford Univ. Press, 2012.

G. REFERENCE BOOKS

- 1. B. Kolman, R. C. Busby, S. C. Ross, Discrete Mathematical Structures, Fourth Indian reprint, Pearson, 2003.
- 2. K. H. Rosen, Discrete Mathematics and Its Applications, McGraw Hill, 2012.
- 3. C. L. Liu, Elements of Discrete Mathematics, McGraw Hill, 2008.
- 4. J. P. Trembly, R. Manohar, Discrete Mathematical Structures with Applications to Computer Science, Tata McGraw–Hill Pub. Co. Ltd, New Delhi, 2003

H. Lecture Plan:

Lecture No.	Торіс
1	Set Theory, operations on sets, venn diagram
2, 3	Relations, types of relations on sets and their properties
4, 5	Relational matrix and the graph of a relation
6	Partitions, Equivalence relations
7, 8	Poset, Hasse diagram
9, 10, 11,	Definitions & Classification of functions, Characteristic function of a set,
12	Hashing functions, Recursive functions, Permutation functions
	Combinatorics: Discrete numeric function, Basic counting principles,
13, 14, 15	Generating functions, Recurrence relations
16	Inclusion and exclusion principle
17	Euler's ϕ function and its applications to Cryptography
	Propositional Calculus: Logical connectives, Truth tables, Tautologies and
18, 19	contradictions
	Contrapositive, converse, inverse, Logical equivalences and implications, De
20, 21	Morgan's Laws
22	Normal forms – PDNF, PCNF
23, 24	Rules of inference, Arguments, Validity of arguments
25	Predicate Calculus: Free and bound variables, Quantifiers
	Theory of inference, the rules of universal specification and generalization,
26, 27	Validity of arguments
	Graph Theory: Definition and examples of graphs, Incidence and degree,
28, 29	Handshaking lemma, Isomorphism Sub-graphs, Weighted Graphs
30, 31	Walks, Paths and Circuits, Eulerian Graphs, Hamiltonian Graphs
	Trees: Definition and properties of trees, pendent vertices, center of a tree,
	rooted and binary tree, spanning tree, minimum spanning tree algorithms,
32, 33	fundamental circuits
34	cut-sets and cut vertices, fundamental cut-sets, the four color theorem
	Directed Graphs: Types of digraphs, directed paths and connectedness,
35, 36	Directed trees
37-48	One tutorial class after every 3 lectures

I. Course Articulation Matrix: (Mapping of COs with POs and PSOs)

0			CORRELATION WITH PROGRAM OUTCOMES CORRELATION WITH PROG SPECIFIC OUTCOMES								PROGRAM
0	STATEMENT	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3
MA1212.1	Apply the operations of sets, find the partition for a set through equivalence classes	3		1				2	3	2	3
MA1212.2	Express a logic sentence in terms of predicates, quantifiers, and logical connectives	3		2			1	2	3	3	3
MA1212.3	Demonstrate an understanding of relations and functions and be able to determine their properties and also determine when a function is I-I and "onto".	3		1				2	3	3	3
MA1212.4	Solve counting problems by applying elementary counting techniques using the product and sum rule, model a recurrent relation and finding solution to the problem by solving recurrence relation	3					1	2	2	2	2
MA1212.5	Use tree and graph algorithms to solve problems and applications to develop skills.	3						2	2	2	3



Faculty of Science

School of Basic Sciences

Department of Chemistry Course Hand-out

Environmental Science |CY 1120 | 3 Credits | 3 0 0 3

Session: Jan 18 – May 18 Faculty: Naveen Kumar Singh | Class: B.Sc. Hons | Semester II

- A. Introduction: This course is offered by Dept. of Chemistry as a Compulsory Course, targeting students who are studying in undergraduate courses of higher education of all branches including Science, Arts, Social Sciences, Design, Business and Commerce, Journalism and Mass Communication. Offers the knowledge of how natural world works, Environmental and natural processes which effects humans and how human activities and developmental processes change the environment and natural systems. Conservation of nature and natural resources, ecosytems and their services, biodiversity loss and its conservation, environmental pollution, effects and control, environmental policies and practices, human communities and the environment. Students are expected to have basic knowledge of science and social sciences for a better learning.
- **B. Course Outcomes:** At the end of the course, students will be able to

[1120.1] Acquire awareness and sensitivity to environmental and its allied problems.

[1120.2] Acquire skills for identifying and solving environmental problems.

[1120.3] Find out the environmental problems concerning with human activities and developmental processes.

[1120.4] Understand the strategies for conservation of nature and natural resources and to solve the emerging problems related to environment degradation.

[1120.5] Understand physical and chemical processes required for environmental sustainability.

[1120.6] Understand chemical processes for waste management and environmental conservation.

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

[POI]. Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.

[PO2]. Effective Communication: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.

[PO3]. Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.

[PO4]. Effective Citizenship: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

[PO5]. Ethics: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.

[PO6]. Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.

[PO7]. Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context socio technological changes.

[PSO.I]: To Recognize and apply the fundamental concepts of chemistry and their applications.

[PSO.2]: To Employ critical thinking and scientific inquiry in the interpretation of theoretical knowledge at a level suitable to succeed at an entry-level position in chemical industry or a post graduate chemistry program.

[PSO.3]: Understand the applications of chemical sciences in the areas of organic synthesis, synthesis of materials, corrosion inhibition, environment sustainability etc.

D. Assessment Plan:

Criteria	Description	Maximum Marks
	Sessional Exam I (Closed Book)	20
Internal Assessment	Sessional Exam II (Closed Book)	20
(Summative)	In class Quizzes and Assignments ,	10
	Activity feedbacks (Accumulated and	
	Averaged)	
End Term Exam	End Term Exam (Closed Book)	50
(Summative)		
	Total	100
Attendance	A minimum of 75% Attendance is requir	red to be maintained by a student to be
(Formative)	qualified for taking up the End Semest	er examination. The allowance of 25%
	includes all types of leaves including medi	cal leaves.
Make up Assignments	Students who misses a class will have to	report to the teacher about the absence.
(Formative)	A makeup assignment on the topic taught	on the day of absence will be given which
	has to be submitted within a week from t	he date of absence. No extensions will be
	given on this. The attendance for that p	particular day of absence will be marked
	blank, so that the student is not accoun	ted for absence. These assignments are
	limited to a maximum of 5 throughout th	e entire semester.
Homework/ Home	There are situations where a student may	<i>i</i> have to work in home, especially before
Assignment/ Activity	a flipped classroom. Although these work	s are not graded with marks. However, a
Assignment	student is expected to participate and per	form these assignments with full zeal since
(Formative)	the activity/ flipped classroom participatio	n by a student will be assessed and marks
	will be awarded.	

E. SYLLABUS

INTRODUCTION TO ENVIRONMENTAL STUDIES Multidisciplinary Nature of Environmental Studies, Scope and importance, concept of sustainability and sustainable development ECOSYSTEMS Concept, structure and function, energy flow in an ecosystem, food chain, food webs and ecological succession, Forest, Grassland, Desert and Aquatic (Ponds, Streams, Lakes, River, Oceans, Estuaries) ecosystem NATURAL RESOURCES (RENEWABLE & NON RENEWABLE RESOURCES) Land Resources and land use change, Land degradation, soil erosion and desertification; Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations. Water: Use and over-exploitation of surface and ground water, floods, droughts, conflicts over water (international & inter-state). Energy resources: Renewable and non- renewable energy sources, use of alternate energy sources, growing energy needs, case studies **BIODIVERSITY AND CONSERVATION** Levels of biological diversity: genetic, species and ecosystem diversity; Biogeographic zones of India; Biodiversity patterns and global biodiversity hot spots, India as a mega-biodiversity nation; Endangered and endemic species of India, Threats to biodiversity: Habitat loss, poaching of wildlife, man---wildlife conflicts, biological invasions; Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity. Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value; ENVIRONMENTAL POLLUTION Environmental Pollution: type, causes, effects, and controls; Air, Water, Soil and Noise pollution, Nuclear hazards and human health risks, ill effects of fireworks, Solid waste management: control measures of urban and industrial waste, pollution case studies ENVIRONMENTAL POLICIES & PRACTICES Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture, Environment laws; Environmental Protection Act, Air (Prevention and Control of Pollution) Act, Water (Prevention and control of Pollution) Act, Wildlife Protection Act, Forest Conservation Act; International agreements: Montreal and Kyoto protocols and Convention on Biological Diversity (CBD). Nature

reserves, tribal populations and rights, and human wildlife conflicts in Indian context **HUMAN COMMUNITIES AND THE ENVIRONMENT** Human population growth: impact on environment, human health and welfare, Resettlement and rehabilitation of project affected persons; case studies, Disaster management: flood, earthquake, cyclone and landslides. Environmental movements: Chipko, Silent valley, Bishnois of Rajasthan, Environmental ethics: Role of Indian and other religions and cultures in environmental conservation, Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi). **Field Work** and visit.

F. TEXT BOOKS

TI. Rajagopalan, R., Environmental Studies: From Crisis to Cure, Oxford University Press, 2016.

T2. De, A. K. Environmental Studies, New Age International Publishers, New Delhi, 2007.

T3. Bharucha, E., Text book of Environmental Studies for undergraduate courses, Universities Press, Hyderabad, 2nd Edition, 2013.

G. REFERENCE BOOKS

RI. Gadgil, M., & Guha, R. This Fissured Land: An Ecological History of India. Univ. of California, Press, 1993.

R2. Carson, R. Silent Spring. Houghton Mifflin Harcourt, 2002.

R3. Groom, Martha J., Gary, K. Meffe, and Carl Ronald Carroll. *Principles of Conservation Biology*. Sunderland: Sinauer Associates, 2006.

R4. Singh, J.S., Singh, S.P., Gupta, S.R. Ecology, Environmental Science and conservation. S. Chand Publishing, New Delhi, 2014.

R5. Sodhi, N.S., Gibson, L. & Raven, P.H. (eds). Conservation Biology: Voices from the Tropics. John Wiley & Sons, 2013.

H. Lecture Plan:

Lec No	Topics	Session Outcome	Mode of Delivery	Corresponding	Mode of	Assessing	the
				СО	Outcome		
	Introduction to Environmental Studies:	Explain about environment and its	Lecture	1120.1	In Class Quiz		
	multidisciplinary nature of environmental	processes and to interpret as			Mid Term I		
	studios	multidisciplinary subject			End Term		
2	Scope and importance, concept of	Recall concept of sustainability,	Lecture	1120.1	Mid Term I		
	sustainability and sustainable development	Explain sustainable development,			End lerm		
		Scope and importance of					
		environmental science					
3,4	Ecosystem: concept, structure and function,	Explain ecosystem with structure,	Lecture	1120.1	In Class Quiz		
	Energy flow in an ecosystem, food chain,	flow of energy, nutrients cycling in			Mid Term I		
	food webs	the ecosystem, food chain and food			End Term		
		webs					
5,6	Forest ecosystem, Grassland ecosystem,	Explain different type ecosystem	Lecture	1120.1	In Class Quiz		
	Desert ecosystem, Aquatic ecosystem	with examples of terrestrial and			Mid Term I		
	(Ponds Streams Lakes River Oceans	aquatic ecosystem and their			End Term		
	(ronds, ourcanis, Lakes, raver, occanis,	importance					
	Estuaries)						
7.8	Ecological succession, Natural Resources	Recall Ecological succession and its	Lecture	1120.1	In Class Quiz		
	(Renewable & Non Renewable Resources):	type, Explain different Natural			Mid Term I		
	Land Resources and land use change. Land	Resources including Land			End lerm		
	degradation	Resources and land use change					
9	Soil erosion and desertification	Recall soil degradation by erosion	Lecture	1120.2	Mid Term I		
		and desertification			End I erm		
10	Deforestation: Causes and impacts due to	Recall Deforestation processes and	Lecture	1120.2	Mid Term I		
	mining, dam building on environment,	their impact on the environment and			End lerm		
	forests, biodiversity and tribal populations	biodiversity					
	Water: Use and over-exploitation of surface	Recall distribution and consumption	Lecture	20.2	Mid Term I		
	and ground water floods droughts conflicts	pattern of water across the world			End Term		
	and ground water, noous, droughts, commets	and its related environmental issues					
	over water (international & inter-state).	including overexploitation and					
		conflicts					

12	Energy resources: Renewable and Non-	Recall different Energy resources	Lecture	1120.2	Mid Term I
	renewable energy sources	including coal, oil, nuclear and their			End Term
		environmental impacts on the			
		environment and on human health			
13	Use of alternate energy sources	Explain other energy resources	Lecture	1120.2	Mid Term I
	6/	including solar, water, wind,			End Term
		geothermal and hydrogen energy for			
		sustainability.			
14	Growing energy needs, case studies	Recall energy demand and supply in	Lecture	1120.2	Mid Term I
		different sector and their			End Term
		environmental concern			
15,16	Biodiversity and conservation: Levels of	Recall different variety and	Lecture	1120.3	Mid Term II
	, hiological diversity: genetic species and	variability of plants and animals			End Term
	biological diversity. genetic, species and	Explain different type of			
	ecosystem diversity; Biogeographic zones of	biodiversity and Biogeographic			
	India	zones of India			
17	Diadiversity patterns and dehel his diversity	Compare biodiversity at national and	Locturo	1120.2	Mid Torm II
17	biodiversity patterns and global biodiversity	global level and acological botspots	Lecture	1120.5	End Term
	hot spots	for their respective biodiversity			End Term
10	India as a more biodiversity nations	Pocall different more diversity	Locturo	1120.3	Mid Torm II
10	india as a mega-biodiversity flation,	nation including India	Lecture	1120.5	End Torm
	Endangered and endemic species of India	Describe different Endangered and			
		ondemic species of India			
10	T I	Endemic species of india	1		Mid Tama II
19	Inreats to biodiversity: Habitat loss,	Explain biodiversity loss and their	Lecture	1120.3	
	poaching of wildlife, man-wildlife conflicts,	reasons, Explain Diological Invasive			End Term
	biological invasions	species and their impact on			
		biodiversity			
20	Ecosystem and biodiversity services:	Explain the goods and services	Lecture	1120.4	Mid Term II
	Ecological, economic, social, ethical,	provided by biodiversity and the			End Term
	aesthetic and informational value	ecosystem			
21	Concernation of biodiversity in site and Ex	Explain different measures of	Locturo	11204	Mid Torm II
21	Conservation of biodiversity. In-situ and Ex-	explain different measures of	Lecture	1120.4	End Term
	situ	Description of National parks			
		wildlife sanctuaries etc			
22	Environmental pollution: type courses	Pocall air pollution and their effects	Locturo	1120 5	Mid Torm II
22	Environmental polition. type, causes,	and explain different air pollutents	Lecture	1120.5	End Torm
	effects, and controls of Air Pollution	and their impacts on onvironment			
		and their impacts on environment			
		and numan nealth			

23	ill effects of fireworks , Controls of Air	Describe harmful impact of	Lecture	1120.5	Mid Term II
	Pollution	fireworks and control methods of			End Term
		air pollutants like ESP, Scrubber			
24	Type, causes, effects of Water Pollution	Describe water pollutants and their	Lecture	1120.5	Mid Term II
		effects, BOD, COD, water quality			End Term
		parameters, DO, TSS			
25	Controls of Water Pollution	Describe conventional and advance	Lecture	1120.5	Mid Term II
		methods for prevention and control			End Term
		of water pollution			
26	Causes, effects of Soil and Noise Pollution,	Explain the Causes, effects of Soil	Lecture	1120.5	Mid Term II
	Nuclear hazards and human health risks	and Noise Pollution, Nuclear			End Term
		hazards and human health risks			
27	Solid waste management: control measures	Describe different type of solid	Lecture	1120.5	Mid Term II
	of urban and industrial waste	waste and their methods of			End Term
	of dibari and industrial waste	management			
28,29	Pollution case studies, Environmental	Recall of environmental pollution	Lecture	1120.6	Mid Term II
	Policies & Practices: Climate change and	with some case studies, Describe			End Term
	debal warming International agroements:	sources and effects of greenhouse			
	giobal warming, international agreements.	gases in global warming and climate			
	Kyoto protocols and Convention on	change and their environmental			
	Biological Diversity (CBD)	impact, Explain different treaties for			
		reduction of greenhouse gases and			
		conservation of biodiversity			
30,3 I	Ozone layer depletion, Montreal protocols,	Explain the importance of ozone	Lecture	1120.6	End Term
	Acid rain and impacts on human	layer and causes of its depletion,			
	communities and agriculture	control measures, Describe the			
		Acid Rain with its effects and			
22.22		control	I	1120 (
32,33	Environment laws; Water (Prevention and	Describe the provision of Water	Lecture	1120.6	End Term
	control of Pollution) Act, Air (Prevention	Act, 1974, Air Act, 1981for			
	and Control of Pollution) Act,	and air pollution Explain EPA 1996			
	Environmental Protection Act.	and an politicion, explain EFA, 1766			
34 35	$Wildlife Protection \Delta ct Ecrost$	Describe the provision of Wildlife	Lecture	1120.6	End Term
57,55	Company tion Act, Notering Act, 101est	Protection Act Forest		1120.0	
	Conservation Act; Nature reserves, tribal	Conservation Act Evoluin			
	populations and rights, and human wildlife	Natura reconver tribal			
	conflicts in Indian context, Human	nature reserves, tribar			
		populations and rights, and			
		human wildlife conflicts in Indian			

	communities and the Environment: Human	context, impact of population growth on environment			
36, 37	Human health and welfare, Resettlement and rehabilitation of project affected persons; case studies, Disaster management: flood, earthquake, cyclone and landslides	Explain human health with respect to environment, measures of disaster management, Describe natural disasters and their impact	Lecture	1120.6	End Term
38	Environmental movements: Chipko, Silent valley, Bishnois of Rajasthan,	Describe different movement in Indian continents for conserve environment and their socio- economic importance	Lecture	1120.6	End Term
39, 40	Environmental ethics: Role of Indian and other religions and cultures in environmental conservation. Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi). Revision on Ecosystem and Natural Resources	Describe role of ethics in preservation and conservation of environment, environmental awareness programme, green enrgy concept and revision	Lecture	1120.6	End Term
41-42	Revision on Biodiversity & Conservation, Environment Pollution and Environmental Policies	Revision for preparation for end term exam	Lecture	1120.6	Class quiz End Term

I. Course Articulation Matrix: (Mapping of COs with POs)

со	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES						COMES	CORRELATION WITH PROGRAM SPECIFIC OUTCOMES			
		PO I	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO I	PSO 2	PSO 3	
CY 1120.1	Acquire awareness and sensitivity to environmental and its allied problems.		1	3			3	2	1	1	I	
CY 1120.2	Acquire skills for identifying and solving environmental problems.	2		1	1	2	3	2			2	
CY 1120.3	Find out the environmental problems concerning with human activities and developmental processes.		I	2	2		3		2	2		
CY 1120.4	Understand the strategies for conservation of nature and natural resources and to solve the emerging problems related to environment degradation.	3				2	3	3	1	1	I	
CY 1120.5	Understand physical and chemical processes required for environmental sustainability.	3	2	I	I	3	3	2	3	3	I	
CY 1120.6	Understand chemical processes for waste management and environmental conservation.	2	1	2	I	3	3	2	3	1	2	

I- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation



School of Basic Sciences

Department of Physics Course Hand-out

Oscillations and wave optics | PY1211 | 3 Credits | 2 1 0 3

Session: Jan 18 – May 19 | Faculty: Dr. K. P. Misra | Class: B.Sc. (Hons) (Chemistry)&(Maths)

A. Introduction: Waves are responsible for basically every form of communication we use. Whether you're talking out loud, texting on your phone, or waving to someone in a crowd there's going to be a wave transmitting information. Learning about the basics of waves and then knowing more about light waves is of utmost importance in today's world. Wave undergo several phenomena like interference, diffraction and polarization. To understand these phenomena and their applications is also very important. This course focusses on these aspects of waves.

B. Course Outcomes: At the end of the course, students will be able to

[1211.1] understand the various types of oscillation and their interactions.

[1211.2] know the superposition of two or more oscillation of same and different frequencies.

[1211.3] understand various fundamental processes of Laser light

[1211.4] analyse the physical interaction of light via various phenomena like interference, diffraction and polarization so as to have skill of understanding behaviour of light on day to day basis.

[1211.5] apply the concepts of waves and oscillations to solve various physical problems on light and its behaviour

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

[PO.1].Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.

[PO.2].Effective Communication: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.

[PO.3].Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.

[PO.4].Effective Citizenship: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

[PO.5].Ethics: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.

[PO.6].Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.

[PO.7].Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes.

D. Assessment Plan:

Criteria	Description	Maximum Marks							
	Sessional Exam I (Close Book)	20							
Internal Assessment	Sessional Exam II (Close Book)	20							
(Summative)	In class Quizzes and Assignments ,	10							
	Activity feedbacks (Accumulated and								
	Averaged)								
End Term Exam	End Term Exam (Close Book)	50							
(Summative)									
	Total	100							
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be								
(Formative)	qualified for taking up the End Semester examination. The allowance of 25%								
	includes all types of leaves including medi	cal leaves.							
Make up Assignments	Students who misses a class will have to	report to the teacher about the absence.							
(Formative)	A makeup assignment on the topic taug	ght on the day of absence will be given							
	which has to be submitted within a	week from the date of absence. No							
	extensions will be given on this. The atte	ndance for that particular day of absence							
	will be marked blank, so that the stude	nt is not accounted for absence. These							
	assignments are limited to a maximum of	5 throughout the entire semester.							
Homework/ Home Assignment/	There are situations where a student	may have to work in home, especially							
Activity Assignment	before a flipped classroom. Although th	nese works are not graded with marks.							
(Formative)	However, a student is expected to par	ticipate and perform these assignments							
	with full zeal since the activity/ flipped cla	ssroom participation by a student will be							
	assessed and marks will be awarded.								

E. SYLLABUS

Oscillations: Potential well and periodic oscillations, harmonic oscillations, differential equation and its solution, kinetic and potential energy, applications of simple harmonic oscillations, oscillations of two masses connected by a spring. Motion of two coupled oscillators, normal modes, N coupled oscillators, damped harmonic oscillator, power dissipation, quality factor, driven harmonic oscillator, transient and steady states, power absorption, resonance in systems with many degrees of freedom. Wave Optics: Lasers: Laser systems: Purity of a spectral line, coherence length and coherence time, spatial coherence of a source, Spontaneous and induced emissions, Einstein's A and B coefficients, conditions for laser action, population inversion, He-Ne Laser, Pulsed lasers and tunable lasers, Applications of Lasers. Interference: The principle of superposition. Two-silt interference, coherence requirement for the sources, Localized fringes; thin films and applications, Fringes of equal inclination, Newton's Ring Experiment, Michelson interferometer and its application for precision determination of wavelength. Diffraction: Fresnel and Fraunhoffer diffraction, Fraunhoffer diffraction due to single silt, Diffraction due to N parallel silts, intensity distribution, plane diffraction grating, reflection grating and blazed gratings. Resolving power of a grating and its comparison with resolving power of prism, Rayleigh criterion. Polarization: Malus law, Brewster's law, Double refraction, phase retardation plates, optical rotation, origin of optical rotation in liquids and in crystals.

F. TEXT BOOKS

- 1. Bajaj N K, Waves and Oscillations, McGraw Hill (2004).
- 2. French A P, Waves and Vibrations, CBS Publications (2003).
- 3. M.N. Avadhanulu M N, Brij Lal and N. Subrahmanyam N A, Text Book of Optics, S. Chand (2006).

G. REFERENCE BOOKS

- 1. Ghosh R K, the Mathematics of Waves and Vibrations, Macmillan, (1975).
- 2. Crawford F, Berkeley Physics Courses: Waves; Vol.-III, McGraw-Hill (2011).
- 3. Jain H J, the Physics of Vibrations and Waves, Macmillan (1975).
- 4. Ghatak A K, Optics, McGraw Hill Edu. (2012).
- 5. Jenkins F and White H, Fundamentals of Optics, McGraw Hill Edu. (2011).
- 6. Khandelwal D P, Optics and Atomic Physics, Himalaya Publishing House, Bombay (1988).

H. Lecture Plan:

LEC NO	TOPICS
1.	Potential well and periodic oscillations, harmonic oscillations, differential equation
	and its solution
2.	kinetic and potential energy, applications of simple harmonic oscillations, oscillations
	of two masses connected by a spring.
3.	Motion of two coupled oscillators, normal modes, N coupled oscillators
4.	damped harmonic oscillator, power dissipation, quality factor, driven harmonic
	oscillator
5.	transient and steady states, power absorption,
6.	
	Tutorial 1
7.	
	resonance in systems with many degrees of freedom.
8.	Laser systems: Purity of a spectral line, coherence length and coherence time, spatial
0	conerence of a source
9.	Spontaneous and induced emissions. Finstein's A and B coefficients
10	
10.	conditions for laser action population inversion
11.	Tutorial 2
12.	He-Ne Laser, Pulsed lasers
13.	
	He-Ne Laser, Pulsed lasers
14.	tunable lasers, Applications of Lasers.
15.	
	Tutorial 3
16.	tunable lasers, Applications of Lasers.
17.	The principle of superposition. Two-silt interference, coherence requirement for the
	sources,
18.	Fringes of equal inclination, Newton's Ring Experiment
19.	TUTORIAL 4
20.	
21	Fringes of equal inclination, Newton's Ring Experiment
21.	Michelson interferometer
22.	Michelson Interferometer and its application for precision determination of
23	Freehol and Fraunhoffer diffraction
23.	
21.	Fraunhoffer diffraction due to single silt
26	Diffraction due to N parallel silts
27.	Diffraction due to N parallel silts
28.	TUTORIALS 6
29.	intensity distribution, plane diffraction grating
30.	reflection grating and blazed gratings
31.	Resolving power of a grating and its comparison with resolving power of prism
32.	Resolving power of a grating and its comparison with resolving power of prism
33.	Rayleigh criterion
34.	TUTORIALS 7
35.	Malus law, Brewster's law,
36.	Double refraction, phase retardation plates,
37.	optical rotation
38.	TUTORIALS 8
39.	origin of optical rotation in liquids and in crystals.
40.	Revision

		CORRELATION WITH PROGRAM OUTCOMES											
СО	STATEMENT	PO	РО	PO	PO	РО	PO	PO	PO	PO	РО	PO	РО
	STATEMENT	1	2	3	4	5	6	7	8	9	10	11	12
PY	understand the various	1	2										
1211.1	types of oscillation and their interactions.												
PY	know the superposition		2	2									
1211.2	of two or more												
	oscillation of same and												
	different frequencies.												
PY	understand various			3	2	2							
1211.3	fundamental processes												
	of Laser light												
PY	analyse the physical						2	2					
1211.4	interaction of light with												
	via various phenomena												
	like interference,												
	diffraction and												
D)/	polarization						-						
PY	apply the concepts of			1			3						
1211.5	waves and oscillations to												
	solve various physical												
	problems on light and its												
	behaviour.												

I- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

J. Course Outcome Attainment Level Matrix:

				A٦	TAINI	MENT	OF PF	ROGRA	ΑΜ ΟΙ	JTCOI	MES		
CO	STATEMENT		-			THRES	HOLD	VAL	JE: 35	%		-	_
	STATEMENT	РО	PO	PO	PO	PO	PO	РО	PO	PO	PO	PO	РО
			2	3	4	5	6	7	8	9	10	11	12
PY	understand the various	3											
1211.1	types of oscillation and												
	their interactions.												
PY	know the superposition		2	2									
1211.2	of two or more												
	different frequencies												
PV	understand various				2	2							
12113	fundamental processes				2	2							
1211.5	of Laser light												
PY	analyse the physical	1					2						
1211.4	interaction of light via												
	various phenomena like												
	interference, diffraction												
	and polarization so as to												
	have skill of												
	understanding behaviour												
	of light on day to day												
	basis.												
PY	apply the concepts of			1		2		3					
1211.5	waves and oscillations to												
	solve various physical												
	problems on light and its												
	behaviour.												

0-No Attainment; I- Low Attainment; 2- Moderate Attainment; 3- Substantial Attainment

School of Basic Sciences

Department of Biosciences Course Hand-out



Mycology, plant Pathology and Lichenology BY 1201 | 3 Credits | 2 1 0 3

Session: 2018-2019 | Faculty: Dr. Jain Rohit| Class: II Semester

- A. Introduction: This course is offered by Dept. of Biosciences as a core course in B.Sc. (pass) Biotechnology, Botany/Bioscience, Chemistry/Psychology and, as a subsidiary course in B.Sc. (Hons) Biotechnology Programme targeting students who wish to pursue their career in the research field of Mycology and Plant Pathology higher studies in the field of Plant pathology or Phytophatology. The course offers in depth knowledge of distribution, morphology, taxonomy, physiology, and ecology, of Fungi including the roles of fungi as both beneficial organisms and as causal agents in plant and animal diseases. Also, the students will learn about Mushroom cultivation and importance, identification, epidemiology and control measures of major diseases of food crops caused by Fungi. Students are expected to have background knowledge of the different types of staining techniques and identification of spores of different fungal pathogens.
- **B. Course Outcomes:** At the end of the course, students will be able to
 - **[BY 1201.1].** Classify Kingdom Mycota on the basis of different morphological and reproductive features
 - **[BY 1201.2].** Identify the habit and habitat and economic importance of fungi
 - **[BY 1201.3].** Interpret the process of heterothallism in fungi and its utility in Mushroom cultivation for enhancing the skills related to organic farming
 - **[BY 1201.4].** Examine the symptoms and major causes of recurrence of diseases in crop plants and analyse the specific defence mechanisms executed by plant for disease resistance
 - **[BY 1201.5].** Investigate and design new methodologies for better yield with less use of pesticides hence enhance the entrepreneurship skills.
 - **[BY 1201.6].** Apply the new protocols for development of disease free high yielding crops and therefore increase the employability in agriculture sector.

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

- **[PO.I].** Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational and personal) from different perspectives.
- **[PO.2].** Effective Communication: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.
- **[PO.3].** Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.
- **[PO.4]. Effective Citizenship:** Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.
- **[PO.5].** Ethics: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.
- [PO.6]. Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.
- **[PSO.1.]** To demonstrate competency in factual content and interpretation of the major biological concept areas of cell and molecular biology, genetics, organismal biology, and evolution and ecology.
- **[PSO.2.]** To demonstrate the ability to identify significant biological research questions, develop research protocols, and properly analyze research questions through the use of the scientific method.
- **[PSO.3.]** Enhance analytical and quantitative skills and demonstrate an understanding of basic computational and statistical techniques in the field of Biotechnology

D. Assessment Plan:

Criteria	Description	Maximum Marks		
	Mid Term Exam I – IA I	20		
Internal Assessment	Mid Term Exam 2 - IA 2	20		
(IA)	CWS Assessment IA 3	10		
	10 marks of IA 3 are awarded based on the various			
	assignments, class tests, seminar presentation etc.			
End Term Exam (EX)	End Term Exam – EX I	50		
	Total	100		

NOTE: A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.

E. SYLLABUS

Fungi: Occurrence, general characteristics, structure, classification (Alexopoulous and Mims, 1979), reproduction, parasexual cycle, heterothallism, mushroom cultivation and importance, Study of life cycle of the following genera: Albugo, Aspergillus, Puccinia. Plant diseases and their control measures: history, classification, symptoms, defense mechanism, mechanism of infection, host parasite interaction, transmission and dissemination of diseases. Causal organisms of disease cycle of the following: green ear disease of Bajra, rust of Crucifers, rusts and smuts of Wheat, red rot of sugarcane. Disease Management: prophylaxis-quarantine measures, seed certification brief account of physical, chemical and biological control. Lichens: General characteristics, structure, types, reproduction and ecological importance,

F. TEXT BOOKS

- 1. Dubey, H.C. An Introduction to Fungi, Vikas Publishing House Pvt., Ltd. Delhi, 2011.
- 2. Pathak, V.N. Khatri N.K. and Pathak, M. Fundamentals of Plant Pathology, Agrobios, Jodhpur, 2012.

G. REFERENCE BOOKS

- I Rangaswamy, G., and Mahadevan A., Diseases of Crop Plants in India, Prentice Hall of India Pvt., New Delhi, 2012.
- 2. Alexopoulous, C.J. Mims, C.W., and Blackwel, M. Introductory Mycology, John Wiley & Sons Inc, New Delhi, 2012.
- 3. Singh, R.S. An Introduction to Principles of Plant Pathology, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 2011.

H. Lecture Plan:

Lecture	Торіс	Session Outcome	Mode of	Corresponding	Mode of
	•		Delivery	co	assessing the
			-		outcome
Ι.	Fungi: Occurrence and distribution and General	Identification of Fungi on the basis of their	Lecture	BY 1201.1	MTE I
	characteristics	characteristic features			Quiz
					End Term
2.	Fungi: Structure and classification (Alexopolous	Differentiation of various fungi in distinct	Lecture	BY 1201.1	MTE I
	& Mims)	groups			Quiz
	,				End Term
3.	Tutorial	Recall the Fungal structure and Classification	Discussion	BY 1201.1	Class Test/ Quiz
4.	Reproduction (Sexual & Asexual), Parasexual	Describe the importance of parasexual cycle	Lecture	BY 1201.2	MTE I
	cycle in Fungi and its importance, Heterothalism	and heterothallism in industry			Quiz/ Class Test
	Homothallism in fungi,	,			End Term
5.	Mushroom cultivation and importance	Learn the procedure for culture the	Lecture	BY 1201.3	MTE I
	·	economically important edible mushrooms			Quiz/ Class Test
		, .			End Term
6.	Tutorial	Recall the importance of parasexuality and	Discussion	BY 1201.3	Class Test &
		heterothallism			Assignments
7.	Study of life cycle of Albugo candida: Asexual	Recall the life cycle of Albugo on the oil	Lecture	BY 1201.4	MTE I
	reproduction in host and disease symptoms	yielding mustard crop			Quiz/ Class Test
					End Term
8.	Albugo candida: Sexual reproduction	Recall the life cycle of Albugo on the oil	Lecture	BY 1201.4	MTE I
		yielding mustard crop			Quiz/ Class Test
					End Term
9.	Tutorial	Discuss the role of Albugo in spread of	Discussion	BY 1201.4	Class Test &
		disease	& Debate		Assignments
10.	Study of life cycle of Aspergillus flavus : Asexual	Understand the growth and development of	Lecture	BY 1201.4	MTE 2
	reproduction and disease symptoms	Aspergillus on the food material			Quiz/ Class Test
					End Term
11.	Aspergillus flavus : Sexual reproduction	Understand the growth and development of	Lecture	BY 1201.4	MTE 2
		Aspergillus on the food material			Quiz/ Class Test
					End Term
12.	Tutorial	Discuss various strains and common diseases	Discussion,	BY 1201.4	Class Test
		caused by Aspergillus	Lecture		End Term

13.	Study of life cycle of <i>Puccinia graminis</i> : Aciospores, Pycniospores and Uredospores, Basidiospores and Teleutospores	Understand the growth and development of the Rust Fungi on Wheat Plant	Lecture	BY 1201.4	MTE 2 Quiz/ Class Test End Term
14.	Puccinia graminis: Sexual reproduction	Understand the growth and development of the Rust Fungi on Wheat Plant	Lecture	BY 1201.4	MTE 2 Quiz/ Class Test End Term
15.	Tutorial	Discuss and understand the occurrence and recurrence of rust disease in every season of wheat	Lecture	BY 1201.4	MTE 2 Debate End Term
16.	Plant pathology: History, definition of disease and general terminology used in plant pathology	Understand the different aspects of study of Plant pathology, Common terminology used in plant diseases	Lecture	BY 1201.5	MTE 2 Quiz/ Class Test End Term
17.	Plant disease: Pathogenesis and pathogenicity, Different stages of pathogenesis	Identify different stages of diseases in plants on the basis of symptoms	Lecture	BY 1201.5	MTE 2 Quiz/ Class Test End Term
18.	Tutorial	Understand the common viral, bacterial and fungal diseases	Lecture/ discussion	BY 1201.5	Quiz/ Class Test End Term
19.	Plant defence mechanism against pathogens, Systemic acquired resistance (SAR),	Describe the defence mechanisms of plants for disease resistance	Lecture	BY 1201.4	MTE 2 Quiz/ Class Test End Term
20.	Plant disease: Host parasite interactions	Understand Physiological and molecular changes in the plants during disease cycle	Lecture	BY 1201.4	MTE 2 Quiz/ Class Test End Term
21.	Tutorial	Describe various mechanism for disease control measures according to the modern methods	Lecture & Discussion	BY 1201.4	End Term Quiz/ Class Test
22.	Green ear disease of Bajra: Causal organism, disease symptoms and occurrence, Disease cycle and control measures	Identify the causes of green ear, its impact on the food crops (Bajra)	Lecture	BY 1201.5	End Term Quiz/ Class Test
23.	Green ear disease of Bajra: Disease cycle and control measures	Recall the methods of disease control	Lecture	BY 1201.5	End Term Quiz/ Class Test
24.	Tutorial	Discuss the possibilities for development of disease resistant and high yielding varieties of Bajra	Lecture/ Discussion	BY 1201.5	Class Test

25.	White rust of Crucifers: Causal organism,	Identify the causes of white rust, its impact	Lecture	BY 1201.5	End Term
	occurrence, disease cycle, Dissemination and	on the oil yielding crops (Mustard) and			Quiz/ Class Test
24	control measures	methods of disease control			5 J T
26.	Rust of wheat: Causal organism, types of rust,	Identify the causes of black rust, its impact on	Lecture	BY 1201.5	End I erm
	disease cycle,	the staple food crop (Wheat)			Quiz/ Class Test
27.	Tutorial	Discuss the possibilities for development of	Lecture/	BY 1201.5	Class Test
		disease resistant and high yielding varieties of	Discussion		
		Wheat			
28.	Black rust, yellow rust and brown rust in wheat	Differentiation of various rust diseases on the	Lecture	BY 1201.5	End Term
	and control measures	host and methods of disease control			Quiz/ Class Test
29.	Loose smut of wheat: Causal organism,	Identify the causes of Loose Smut , its impact	Lecture	BY 1201.5	End Term
	occurrence, disease cycle, control measures	on the staple food crop (Wheat) and			Quiz/ Class Test
		methods of disease control			
30.	Tutorial		-	-	Class Test
31.	Red rot of sugarcane: Causal organism,	Identify the causes of Loose Smut , its impact	Lecture	BY 1201.5	End Term
	occurrence, disease cycle and disease control	on the economically important food crop			Quiz/ Class Test
		(Sugarcane) and methods of disease control	-		
32.	Disease Management: prophylaxis-quarantine	Understand treatment of seeds before	Lecture	BY 1201.6	End lerm
	measures, Seed certification brief account of	sowing for disease resistance and methods of			Quiz/ Class Test
	physical, chemical and biological control	control of disease using chemical and			
	—	biological agents			
33.	lutorial		-	-	Class Test
34.	Lichens: General characteristics, structure,	Understand the association of Fungi and	Lecture	-	End Term
	types	Algae			Quiz/ Class Test
35.	Lichens: reproduction and ecological	Understand the importance of lichens in the	Lecture	-	End Term
	importance	industry			Quiz/ Class Test
36.	Tutorial		-	-	Class Test
Lab	Preparation of slides to identify different types	Identify different types of disease causing	Lab sessions	BY 1201.1	Experimental
Sessions	of fungus based on their morphological and	fungus by studying their morphological and		BY 1201.4	results in 24 lab
	sexual characteristics.	reproductive characteristics.			sessions
	To conduct field study for identification of	Identify the type of infection in selected plant			End Term Practical
	different types of disease patterns in plants.	species			Examination

I. Course Articulation Matrix: (Mapping of COs with POs)

со	STATEMENT		CORRELATION WITH PROGRAM OUTCOMES							CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
		PO I	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO I	PSO 2	PSO 3	
[BY 1201.1].	Classify Kingdom Mycota on the basis of different morphological and reproductive features								I			
[BY 1201.2].	Identify the habit and habitat and economic importance of fungi											
[BY 1201.3].	Interpret the process of heterothallism in fungi and its utility in Mushroom cultivation for enhancing the skills related to organic farming								1			
[BY 1201.4].	Examine the symptoms and major causes of recurrence of diseases in crop plants and analyse the specific defence mechanisms executed by plant for disease resistance	I			I				I			
[BY 1201.5].	Investigate and design new methodologies for better yield with less use of pesticides hence enhance the entrepreneurship skills.						I	I				
[BY 1201.6].	Apply the new protocols for development of disease free high yielding crops and therefore increase the employability in agriculture sector.			I						2		

I- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

School of Basic Sciences

Department of Biosciences Course Hand-out



Gymnosperms and Palaeobotany| BY 1202 | 3 Credits | 2 | 0 3

Session: 2018 - 2019 | Faculty: Sharma Madan Mohan | Class: II Semester

- A. Introduction: This course is offered by Dept. of Biosciences as a core course in B.Sc. (pass) Biotechnology, Botany/Bioscience, Chemistry/Psychology and, as a subsidiary course in B.Sc. (Hons) Biotechnology Programme targeting students who wish to pursue their career in the research field of Gymnosperms and Palaeobotany and higher studies in the field of palyantology and Palaeobotany. The course offers in depth knowledge of distribution, morphology, taxonomy, physiology and ecology of Gymnosperms. Also, the students will learn about different ornamental Gymnosperm plants used in homes. Palaeobotany is an interesting area of research as it deals with the fossils and extinct species. Student will learn to identify different types of fossils, process of fossilization and techniques of fossil preservation. The study of geological time scale will allow the students to understand the process of evolution throughout the last many billions of years. Students are expected to have background knowledge of the different classification systems of fossils and Gymnosperms.
- **B. Course Outcomes:** At the end of the course, students will be able to
 - **[BY 1202.1].** Identify various Gymnosperms in the nature based on their characteristics.
 - **[BY 1202.2].** Locate the sites from where Gymnosperms can be collected and classify Gymnosperms as per their varied importance
 - [BY 1202.3]. Identify importance of Gymnosperms as ornamental plant as well as food
 - [BY 1202.4]. Critically analyse geological time scale and Palaeobotany in modern day science to develop skills related to Palaeobotany
 - [BY 1202.5]. Assess their importance as food, medicine, ornament, fossil fuel etc. and develop employability skills
 - **[BY 1202.6].** Develop the protocol to preserve fossils and identification of their age and locations where fossil fuel (petroleum) is abundant

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

- **[PO.I].** Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational and personal) from different perspectives.
- **[PO.2].** Effective Communication: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.
- **[PO.3].** Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.
- **[PO.4].** Effective Citizenship: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.
- **[PO.5].** Ethics: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.
- **[PO.6].** Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.
- **[PO.7].** Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes.
- **[PSO.I.]** To demonstrate competency in factual content and interpretation of the major biological concept areas of cell and molecular biology, genetics, organismal biology, and evolution and ecology.
- **[PSO.2.]** To demonstrate the ability to identify significant biological research questions, develop research protocols, and properly analyze research questions through the use of the scientific method.
- **[PSO.3.]** Enhance analytical and quantitative skills and demonstrate an understanding of basic computational and statistical techniques in the field of Biotechnology

D. Assessment Plan:

Criteria	Description	Maximum Marks		
	Mid Term Exam I – IA I	20		
Internal Assessment	Mid Term Exam 2 - IA 2	20		
(IA)	CWS Assessment IA 3	10		
	10 marks of IA 3 are awarded based on the various			
	assignments, class tests, seminar presentation etc.			
End Term Exam (EX)	End Term Exam – EX I	50		
	Total	100		

NOTE: A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.

E. SYLLABUS

Gymnosperms: Occurrence, distribution, general characteristics, classification (Sporne, 1974; Kremer and Green, 1990), evolution of seed habit, origin and evolution of gymnosperms and economic importance, Life cycle of the following genera: Cycas, Pinus, Ephedra. Comparative study of gymnosperms, angiosperms and pteridophytes. Palaeobotany: Geological time scale. Fossilization: types of fossils, techniques for study of fossils. Applied aspects of fossils: use in coal and petroleum exploration. Study of primitive land plant: Rhynia; Fossil Pteridophyta: Lepidodendron; Fossil Gymnosperm: Williamsonia.

F. TEXT BOOKS

- 1. Bhatnagar, S. P. and Moitra, A. Gymnosperms, New Age International Pvt. Ltd., New Delhi, 2010.
- 2. Purohit, S. and Vyas. A Text Book of Gymnosperms, Ramesh Book Depot, Jaipur, 1997.

G. REFERENCE BOOKS

- I Sporne, K. R. The Morphology of Gymnosperms, Hutchinson and Co. Ltd., London, 1994.
- 2. Stewart, W.N. and Rathwell, G.W. Palaeobotany and the Evolution of Plants, Cambridge University Press, Cambridge, 1993.
- 3. Chamberlain, C. J. Gymnosperms: Structure and Evolution, CBS Publishers and Distributors, New Delhi, 2010.

Lecture	Topic Session Outcome		Mode of	Corresponding	Mode of
	-		Delivery	СО	assessing the
			-		outcome
Ι.	Gymnosperms: Occurrence, distribution,	Identification of Gymnosperms on the basis of	Lecture	BY 1202.1	MTE I
	general characteristics	their characteristic features			Quiz
	•				End Term
2.	Gymnosperms: Classification proposed by	Distinguished characteristics which classify the	Lecture	BY 1202.1	MTE I
	Sporne, Kremer & Green	gymnosperms and outline of the proposed			Quiz
		classification system			End Term
3.	Tutorial	Remembrance the general characteristic and	Discussion	-	Oral test
		Classification			
4.	Evolution of seed habit and its significance, Origin	Describe the importance of Heterospory for	Lecture	BY 1202.2	MTE I
	and evolution of gymnosperms and economic	evolution of seed habit and its importance			Quiz/ Class Test
	importance	•			End Term
5.	Cycas: External morphology (Root, stem, leaf)	Learn the external morphology of organs of	Lecture	BY 1202.3	MTE I
		gymnosperms			Quiz/ Class Test
					End Term
6.	Tutorial	Recall the importance and evolution of seed	Discussion	-	Class Test &
		habit and external features			Assignments
7.	Cycas: Internal structure of coralloid root and	Recall the anatomical features of coralloid	Lecture	BY 1202.3	MTE I
	normal root	root and normal root			Quiz/ Class Test
					End Term
8.	Cycas: Internal structure of young and mature	Recall the anatomical features of young and	Lecture	BY 1202.3	MTE I
	stems	mature stems			Quiz/ Class Test
					End Term
9.	Tutorial	Discuss the differentiating internal structures	Discussion	-	Class Test &
		of the different organs of Cycas			Assignments
10.	Cycas: Internal structure of foliage leaf – Rachis	Understand the role of different tissues of leaf	Lecture	BY 1202.3	MTE 2
	and leaflet	lamina and rachis of Cycas			Quiz/ Class Test
					End Term
11.	Cycas: Shoot apex organization and vegetative	Recognize the mode of vegetative	Lecture	BY 1202.4	MTE 2
	reproduction	reproduction in gymnosperms			Quiz/ Class Test
					End Term
12.	Tutorial	Discussion	Discussion	-	Class Test
			& debate		End Term

13.	Sexual reproduction in Cycas: Structure and development of male cone (microsporangium)	Understand the development of sexual structure and mode of sexual reproduction	Lecture	BY 1202.4	MTE 2 Quiz/ Class Test End Torm
14.	Embryo development in Cycas and Germination of seed	To understand the development of embryo and further change in to seed	Lecture	BY 1202.4	MTE 2 Quiz/ Class Test End Term
15.	Tutorial	Discussion of the cycas	Interaction/	-	MTE 2 Debate End Term
16.	Pinus: External morphology of root, stem, leaf	Understand the different external features of Pinus	Lecture	BY 1202.5	MTE 2 Quiz/ Class Test End Term
17.	Pinus: internal structure of root and stem	Identify the plant based on the anatomical characteristics and authenticate the same.	Lecture	BY 1202.5	MTE 2 Quiz/ Class Test End Term
18.	Tutorial	Discussion/ problem solving	Lecture/ discussion	-	Quiz/ Class Test End Term
19.	Pinus: foliage leaf – internal structure	Identify the plant based on the anatomical characteristics of leaf and authenticate the same.	Lecture	BY 1202.4	MTE 2 Quiz/ Class Test End Term
20.	Pinus: Reproduction- Structure of Male and female cone, development of microsporangium and ovule	Understand the structure and development of reproductive organs in Pinus	Lecture	BY 1202.4	MTE 2 Quiz/ Class Test End Term
21.	Tutorial	Problem solving/ discussion	Discussion	-	End Term Quiz/ Class Test
22.	Pinus: Fertilization and embryo development, seed development	Able to understand the requirement of seed production and precautions	Lecture	BY 1202.5	End Term Quiz/ Class Test
23.	Ephedra: External morphology	Understand the external features of Ephedra	Lecture	BY 1202.5	End Term Quiz/ Class Test
24.	Tutorial	Comparison of external characteristics of Ephedra with Cycas and Pinus. Recall morphology of Cycas and Pinus	Discussion	-	Class Test
25.	Ephedra: Internal structure of root, stem and leaf	Identify the specific characteristics of anatomy of root, stem and leaf.	Lecture	BY 1202.5	End Term Quiz/ Class Test

26.	Ephedra: Male and female cone and their	Understand the structure and development of	Lecture	BY 1202.6	End Term
	development, Development of male and female gametophytes	reproductive organs in Ephedra			Quiz/ Class Test
27.	Tutorial	Recall the points for comparison of structure,	Recall/	-	Class Test
		development of reproductive structures.	Discussion		
28.	Ephedra: Fertilization and Embryo development;	Understand the process for embryogeny and	Lecture	BY 1202.5	End Term
	Seed germination	seed germination.			Quiz/ Class Test
29.	Palaeobotany: Introduction and scope,	Recognise the characteristics of fossils and	Lecture	BY 1202.5	End Term
	Geological time scale	their scope			Quiz/ Class Test
30.	Tutorial	Recall the special features of fossils and some	Recall/	-	Class Test
		of the fossils	Discussion		
31.	Fossilization: types of fossils, techniques for study	Identify the fossils and understand the various	Lecture	BY 1202.6	End Term
	of fossils	steps of fossilization			Quiz/ Class Test
32.	Applied aspects of fossils: use in coal and	Review applications of fossils in petroleum	Lecture	BY 1202.6	End Term
	petroleum exploration. Study of primitive land	industry			Quiz/ Class Test
	plant: Rhynia				
33.	Tutorial	Recall the features of fossils and resolve the issues of students	Discussions	-	Class Test
34.	Fossil Pteridophyta: Lepidodendron	Understand the life cycle of Lepidodendron	Lecture	BY 1202.6	End Term
					Quiz/ Class Test
35.	Fossil Gymnosperm: Williamsonia	Understand the life cycle of Williamsonia	Lecture	BY 1202.6	End Term
					Quiz/ Class Test
36.	Tutorial	Doubt clearance and interaction	Discussion	-	Class Test
Lab	Preparation of slides to identify different types of	Identify different types of disease causing	Lab sessions	BY 1202.1	Experimental
Sessions	Gymnosperms based on their morphological,	fungus by studying their morphological and		BY 1202.2	results in 24 lab
	anatomical and sexual characteristics.	reproductive characteristics.		BY 1202.3	sessions
	Field visit along with campus visit for	Identify the type of infection in selected plant		BY 1202.4	End Term Practical
	identification of gymnopserms	species			Examination

I. Course Articulation Matrix: (Mapping of COs with POs & PSOs)

со	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES							CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
		PO I	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO I	PSO 2	PSO 3
BY 1202.1	Identify various Gymnosperms in the nature based on their characteristics.	Ι							I		
BY 1202.2	Locate the sites from where Gymnosperms can be collected and classify Gymnosperms as per their varied importance		1							1	I
BY 1202.3	Identify importance of Gymnosperms as ornamental plant as well as food			Ι						I	
BY 1202.4	Critically analyse geological time scale and Palaeobotany in modern day science to develop skills related to Palaeobotany			Ι	I						
BY 1202.5	Assess their importance as food, medicine, ornament, fossil fuel etc. and develop employability skills			1			I	I			1
BY 1202.6	Develop the protocol to preserve fossils and identification of their age and locations where fossil fuel (petroleum) is abundant		I								

I. Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

School of Basic Sciences

Department of Chemistry Course Hand-out

Inorganic Chemistry III | CY1313 | 4 Credits | 3 1 0 4

Session: Jul 18 – Nov 18 | Faculty: Arunava Agarwala | Class: 3rd Semester B. Sc. (Chemistry Hons.)

- A. Introduction: This course is offered by Dept. of Chemistry for 3rd Semester B. Sc. (Chemistry Hons.) students. The objective of the course is to acquaint the students with the basic concepts of chemistry of main group (p-block elements) elements and preliminary understanding of molecular symmetry. The student with the knowledge of the basic chemistry will understand and explain scientifically various chemistry related problems.
- B. Course Outcomes: At the end of the course, students will be able to
 - **[CY1313.1].** Apply current chemistry models/theories to understand and predict the physical/electronic properties, bonding, and reactivity of p-block elements.
 - [CY1313.2]. Develop an understanding of the chemistry of elements (p-block) in the periodic table and their compounds.
 - **[CY1313.3].** Establish an appreciation of the role of inorganic chemistry in the chemical sciences.
 - **[CY1313.4].** Provide employability by understanding the chemical methods employed for problem solving involving inorganic systems.
 - **[CY1313.5].** Develop skill and understanding of the professional and safety responsibilities residing in working with inorganic systems.
 - **[CY1313.6].** Identify symmetry elements and recognise symmetry operations generated by each symmetry element for a given molecule.

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

- [PO.1]. Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to whichthese assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives
- [PO.2]. Effective Communication: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, andmake meaning of the world by connecting people, ideas, books, media and technology
- [PO.3]. Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.
- [PO.4]. Effective Citizenship: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informedawareness of issues and participate in civic life through volunteering.
- [PO.5]. Ethics: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.
- [PO.6]. . Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.
- [PO.7]. Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context socio-technologicalchanges
- [PSO.1]. Recognize and apply the fundamental concepts of chemistry and their applications.
- [PSO.2]. Employ critical thinking and scientific inquiry in the interpretation of theoretical knowledge at a level suitable to succeed at an entry-level position in chemical industry or a post graduate chemistry program.
- [PSO.3]. Understand the applications of chemical sciences in the areas of organic synthesis, synthesis of materials, corrosion inhibition, environment sustainability etc. Apply these principles both in simple exercises and in more complex problems of Chemistry

D. Assessment Plan:

Criteria	Description	Maximum Marks					
	Sessional Exam I (Closed Book)	20					
Internal Assessment	Sessional Exam II (Closed Book)	20					
(Summative)	Assignments and Class tests	10					
	(Accumulated and Averaged)						
End Term Exam	End Term Exam (Closed Book)	50					
(Summative)							
	Total	100					
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be						
(Formative)	qualified for taking up the End Semester examination. The allowance of 25%						
	includes all types of leaves including medical leaves.						
Homework/ Home Assignment/ Activity	There are situations where a student may have to work in home. Although these						
Assignment	works are not graded with marks. However, a student is expected to participate						
(Formative) and perform these assignments with full zeal since the activity will help							
students in developing better understanding.							

E. SYLLABUS

The p-Block Elements-II: Chemical reactivity and group trends of N, P, As, Sb & Bi, compounds of of N, P, As, Sb & Bi, some organometallic compounds; Oxygen, S, Se and Te Family: Chemical Reactivity, group trends and stereochemistry, dioxygen as a ligand, structure of O₃ and H₂O₂, clathrate hydrates allotropic forms of S & Se,structures of halides, oxides and oxyacids of S, Se &Te, liquid SO₂ and polyatomic cations of S, Se &Te; The Halogen Family: Chemical reactivity, group trends, chemistry of preparation of fluorine, hydrogen halides, HF as a solvent, inter-halogen compounds, polyhalide and polyhalonium ions, polyatomic cations of halogens, oxides and oxyacide of halogens; Noble gases: Chemical reactivity and group trends, Clathrate compounds; preparation, structure and bonding of noble gas compounds; Symmetry and group theory (Part I): Symmetry elements and symmetry operations, point groups, definitions of group, subgroup relation between orders of a finite group and its subgroup, group multiplication tables, conjugacy relation and classes Schoen flies symbols, representation of groups, character of a representation; Symmetry and group theory (Part II): Properties of irreducible representations, the great orthogonality theorem and its importance. Character Tables, Symmetry criteria for optical activity, symmetry restrictions on dipole moment, and hybridization schemes of orbitals.

F. TEXT BOOKS

A book or a set of books which covers 60% or more of the syllabus can be written under this category. (Not more than 3)

- 1. Lee, J. D., Concise Inorganic Chemistry. ELBS Publication, 2010.
- 2. Malik, W. U., Tuli, R. D. and Madan, G. D. Selected Topics in Inorganic Chemistry, S. Chand group company, 2010.
- 3. Shriver & Atkins' Inorganic Chemistry, Oxford University Press

G. REFERENCE BOOKS

- 1. Cotton F. A. and Wilkinson, G. Advanced Inorganic Chemistry, John Wiley, 2011.
- 2. Huhey, J. E., Inorganic chemistry: principles of structure and reactivity. Harper and Row, 2010

H. Lecture Plan:

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Lecture number	Topics
1	Group 15 elements: Electronic structure and oxidation states; Occurrence and extraction of elements.
2	General properties of the elements: Metallic and non-metallic character of the elements; Reactivity
3	Hydrides of the elements: Ammonia (NH ₃); Ammonium salts, Hydrazine (NH ₂ -NH ₂), Phosphine (PH ₃) Arsine (AsH ₃)
4	Liquid ammonia as solvent
5	Fertilizers: Nitrogen fixation, Haber-Bosch process.
6	Halides of the elements: Trihalides and pentahalides of the elements.
7	Oxides of the elements: Oxides of Nitrogen (N ₂ O, NO, N ₂ O ₃ , N ₂ O ₄ , N ₂ O ₅)
8	Oxides of the elements: Oxides of phosphorus, arsenic and bismuth.
9	Oxoacids of Nitrogen: Nitrous acid (HNO $_3$) and nitric acid (HNO $_3$)
10	Oxoacids of Phosphorus: The phosphoric acid series and the phosphorous acid series
11	Sulphides of phosphorous and Phosphazenes(phosphonitrilic compounds)
12	Revision: Group 15 elements
13	Group 16 elements (chalcogenes): Electronic structure and oxidation states; Occurrence and extraction of elements.
14	General properties of the elements: Metallic and non-metallic character of the elements; Reactivity, Allotropy
15	General properties and preparation of the oxides: Normal oxide, peroxide, suboxide, super oxide.
16	Oxides of sulphur, selenium, tellurium and polonium: Dioxide, trioxide
17	Oxoacids of sulphur: Sulphuric acid, sulphurious acid, thionic acid, peroxo acid
18	Oxohalides: Thionyl compounds, sulphuryl compounds
19	Hydrides and halides: Water, Hydrogen peroxide,
20	Revision: : Group 16 elements
21	Group 17 elements (Halogens): Electronic structure and oxidation states; Occurrence and extraction of elements.
22	General properties of the elements: Metallic and non-metallic character of the elements; Reactivity, bond energy of X ₂ molecule, oxidizing power.
23	Hydrogen halides: HF, HCl, HBr and HI
24	Halides: Ionic halides, Molecular (covalent) halides and bridging halide
25	Halogen oxides: Oxides of fluorine, chlorine, bromine and iodine
26	Oxoacids: Hypohalous acids (HOX), halous acid (HXO ₂)

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27	Oxoacids (contd) : Halic acid (HXO ₃) and perhalic acid (HXO ₄)
28	Strength of oxoacids and standard reduction potential of these acids.
29	Inter-halogen compounds: AX, AX ₃ , AX ₅ and AX ₇ types compounds.
30	Poly-halides, pseudohalogens and pseudohalides.
31	Revision: Group 17 elements
32	Group 18 elements (Noble gases): Electronic structure and oxidation states; Occurrence and extraction of elements.
33	General properties and uses of these elements.
34	Chemical properties of helium
35	Chemical properties of neon and argon
36	Chemistry of xenon and various xenon compound: Xenon fluoride compounds
37	Clathrate compounds: Definition and examples.
38	Revision: Group 18 elements
39	Introduction to symmetry analysis
40	Symmetry operations, elements and point groups
41	Symmetry operations, elements and point groups (Contd.) : Practice with example
42	Applications of symmetry: Polar molecules , Chiral molecules
43	Applications of symmetry: Molecular vibrations.
44	The symmetries of molecular orbitals: Symmetry-adapted linear combinations
45	The construction of molecular orbitals.
46	Revision

I. Course Articulation Matrix: (Mapping of COs with POs)

		CORRELATION WITH PROGRAM							CORRELATION WITH PROGRAM				
со	STATEMENT		OUTCOMES							SPECIFIC OUTCOMES			
		PO	PO	PO	PO	PO	РО	PO	PSO 1	PSO 2	PSO 3		
		1	2	3	4	5	6	7					
CY	Course Outcome	1	1	2	1				1				
1313.1	statement												
CY	Course Outcome	2			1					2			
1313.2	statement												
CY	Course Outcome	1					1				3		
1313.3	statement												
CY	Course Outcome	2								1			
1313.4	statement												
CY	Course Outcome	1		1			2		2				
1313.5	statement												
CY	Course Outcome	1									2		
1313.6	statement												
J. Course Outcome Attainment Level Matrix:

<u> </u>	CTATEBAENIT		ATTAINMENT OF PROGRAM OUTCOMES										ATTAINMENT OF			
0	STATEIVIENT			10	KESH		ALUE	: 40%								
		DO		50		DO		DO 7		DO						
		PO	PO	PO	P0	P0 -	PO	PO 7	PO	PO	PSO	PSO	PSO			
		1	2	3	4	5	6		8	9	1	2	3			
CY	Course Outcome															
1313.1	statement															
CY	Course Outcome															
1313.2	statement															
CY	Course Outcome															
1313.3	statement															
CY	Course Outcome															
1313.4	statement															
CY	Course Outcome															
1313.5	statement															
CY	Course Outcome															
1313.6	statement															

0-No Attainment; 1- Low Attainment; 2- Moderate Attainment; 3- Substantial Attainment



School of Basic Sciences

Department of Chemistry Course Hand-out

Organic Chemistry-III | CY 1315 | 4 Credits | 3 | 0 4

Session: Jul 18 - Nov 18 | Faculty: Dr. Rahul Shrivastava| Class: Third Semester (B Sc Chemistry (Hons))

- A. Introduction: This course is offered by Dept. of Chemistry. CY 1315 is the third course in the four semester organic chemistry lecture sequence that includes CY1113, CY1213, CY 1315 and CY 1414. It is a continuation of courses CY1113, CY1213 and emphasizes on the chemistry of Stereochemical principles, conformation, steric and stereoelectronic effects, Free radical reactions, Carbanions and other nucleophilic carbon species and their reactions, Aldehydes and Ketones, Carboxylic Acids and their derivatives. It provides a bridge between basic and more advanced organic chemistry knowledge
- **B. Course Outcomes:** At the end of the course, students will be able to

[1315.1]. Interpret the enantiomeric and diastereomeric relationship and illustrate application of the stereochemical principles to the structures and functions of acyclic and cyclic molecules

[1315.2]. Elaborate the effect of conformation on reactivity.

[1315.3]. Explain the general characteristics and methods of preparation of free radicals and nucleophiles

[1315.4]. Recognize the general methods of preparation of aldehydes, ketones, carboxylic acids and their derivatives and skill development to analyse it

[1315.5]. Recall the different types of effects and their effect on relative strength of carboxylic acids and relative stability of acyl derivatives

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

PO1. Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.

PO2 .Effective Communication: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.

PO3. Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.

PO4. Effective Citizenship: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

PO5. Ethics: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.

PO6. Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.

PO7. Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes

PSO1. Recognize and apply the fundamental concepts of chemistry and their applications.

PSO2. Employ critical thinking and scientific inquiry in the interpretation of theoretical knowledge at a level suitable to succeed at an entry-level position in chemical industry or a post graduate chemistry program.

PSO3. Understand the applications of chemical sciences in the areas of organic synthesis, synthesis of materials, corrosion inhibition, environment sustainability etc.

D. Assessment Plan:

Criteria	Description	Maximum Marks				
	Sessional Exam I	20				
Internal Assessment	Sessional Exam II	20				
(Summative)	In class Quizzes and Assignments ,	10				
	Activity feedbacks (Accumulated and					
	Averaged)					
End Term Exam	End Term Exam	50				
(Summative)						
	Total	100				
Attendance	A minimum of 75% Attendance is requi	red to be maintained by a student to be				
(Formative)	qualified for taking up the End Semest	er examination. The allowance of 25%				
	includes all types of leaves including medi	cal leaves.				
Homework/ Home Assignment/	There are situations where a student may	y have to work in home, especially before				
Activity Assignment	a flipped classroom. Although these work	s are not graded with marks. However, a				
(Formative)	student is expected to participate and per	form these assignments with full zeal since				
	the activity/ flipped classroom participation	on by a student will be assessed and marks				
	will be awarded.					

E. SYLLABUS

Stereochemical principles, conformation, steric and stereoelectronic effects: Enantiomeric relationships, diastereomeric relationships, dynamic stereochemistry, prochiral relationships, conformations of acyclic molecules, cyclohexane derivatives, rings other than six membered, conformational effects on reactivity; Free radical reactions: Generation and characterization of free radicals, characteristics of reaction mechanisms involving electron transfer reactions; Carbanions and other nucleophilic carbon species and their reactions: Acidity of hydrocarbons, carbanions stability by functional groups, Generation of carbon nucleophiles by deprotonations, reactions involving carbanions; Aldehydes and Ketones: Nomenclature and structure of the carbonyl group; Synthesis of aldehydes and ketones, physical properties, of aldehydes and ketones; Carboxylic Acids: Nomenclature, structure and bonding, physical properties, acidity of carboxylic acids, effects of substituents on acid strength. Preparation of carboxylic acids, Reactions of carboxylic acids; Carboxylic Acid Derivatives: Structure and nomenclature of acid chlorides, esters, amides (urea) and acid anhydrides, relative stability of acyl derivatives.

F. TEXT BOOKS

- 1. R. T. Morrison, R. N. Boyd and S. K. Bhattacharjee, Organic Chemistry, Pearson India, 2011.
- 2. P. Sykes, A Guidebook to Mechanism in Organic Chemistry, Pearson India, 2003.
- 3. I.L. Finer, Organic Chemistry, Volume I, Pearson India, 2002.

REFERENCE BOOKS

- 1. F. A. Carey and R. J. Sundberg, Advanced Organic Chemistry: Structure And Mechanisms (Part A), Springer India Private Limited, 2007.
- 2. M. B. Smith, J. March, March's Advanced Organic Chemistry: Reactions, Mechanisms and Structure, Wiley, 2012.

I. Lecture Plan:

Lecture No.	Topics	Session Outcome	Mode of Delivery	Corresponding CO	Mode of Assessing the
I	Introduction and Course Hand-out briefing	Interpret the enantiomeric and diastereomeric relationship and illustrate application of the stereochemical principles to the structures and functions of acyclic and cyclic molecules	Lecture	1315.1	Outcome Mid Term I End Term
2	Enantiomeric relationships, Diastereomeric relationships	Interpret the enantiomeric and diastereomeric relationship and illustrate application of the stereochemical principles to the structures and functions of acyclic and cyclic molecules	Lecture	1315.1	Mid Term I End Term
3	Dynamic stereochemistry, Prochiral relationships	Interpret the enantiomeric and diastereomeric relationship and illustrate application of the stereochemical principles to the structures and functions of acyclic and cyclic molecules	Lecture	1315.1	Mid Term I End Term
4	Dynamic stereochemistry, Prochiral relationships	Elaborate the effect of conformation on reactivity.	Lecture	1315.2	Mid Term I End Term
5	Conformations of acyclic molecules, cyclohexane derivatives	Elaborate the effect of conformation on reactivity.	Lecture	1315.2	Mid Term I End Term

6	Conformations of acyclic molecules, cyclohexane derivatives,	Elaborate the effect of conformation on reactivity.	Lecture	1315.2	Mid Term I End Term
7	Rings other than six membered	Elaborate the effect of conformation on reactivity.	Lecture	1315.2	Mid Term I End Term
8	Conformational effects on reactivity	Elaborate the effect of conformation on reactivity.	Lecture	1315.2	Mid Term I End Term
9	Revision	Elaborate the effect of conformation on reactivity.	Lecture	1315.1 and 1315.2	Mid Term I End Term
10	Generation and characterization of free radicals	Explain the general characteristics and methods of preparation of free radicals and nucleophiles	Lecture	1315.3	Mid Term I End Term
11	Generation and characterization of free radicals	Explain the general characteristics and methods of preparation of free radicals and nucleophiles	Lecture	1315.3	Mid Term I End Term
12	Characteristics of reaction mechanisms involving electron transfer reaction	Explain the general characteristics and methods of preparation of free radicals and nucleophiles	Lecture	1315.3	Mid Term I End Term
13	Characteristics of reaction mechanisms involving electron transfer reactions	Explain the general characteristics and methods of preparation of free radicals and nucleophiles	Lecture	1315.3	Mid Term I End Term
4	Carbanions stability by functional groups	Explain the general characteristics and methods of preparation of free radicals and nucleophiles	Lecture	1315.3	Mid Term I End Term

15	Generation of carbon	Explain the general	Lecture	1315.3	Mid Term I
	nucleophiles by	characteristics and			End Term
	deprotonations	methods of preparation of			
		free radicals and			
		nucleophiles			
16	Revision Class	Explain the general	Interactive/Self study	1315.3	NA
		characteristics and			
		methods of preparation of			
		free radicals and			
		nucleophiles			
17	Reactions involving	Explain the general	Lecture	1315.3	Mid Term II
	carbanions	characteristics and			End Term
	carbanions	methods of preparation of			
		free radicals and			
		nucleophiles			
18	Nomenclature of	Explain the general	Lecture	1315.3	Mid Term II
	Organic compounds	characteristics and			End Term
	organie compounds	methods of preparation of			
		free radicals and			
		nucleophiles			
19	Revision	Explain the general	Lecture	1315.3	Mid Term II
		characteristics and			End Term
		methods of preparation of			
		free radicals and			
		nucleophiles			
20	Structure of the	Recognize the general	Lecture	1315.4	Mid Term II
	carbonyl group	methods of preparation of			End Term
		aldehydes, ketones,			
		carboxylic acids and their			
		derivatives and skill			
		development to analyse	-		
21	Synthesis of aldehydes	Recognize the general	Lecture	1315.4	Mid Term II
		methods of preparation of			End Term
		aldehydes, ketones,			
		carboxylic acids and their			
		derivatives and skill			
		development to analyse			
22	Synthesis of ketones	Recognize the general	Lecture	1315.4	Mid Ierm II
		methods of preparation of			End lerm
		aldehydes, ketones,			
		carboxylic acids and their			
		derivatives and skill			
		development to analyse			

23	Physical properties, of aldehydes and ketones	Recognize the general methods of preparation of aldehydes, ketones, carboxylic acids and their derivatives and skill development to analyse	Lecture	1315.4	Mid Term II End Term
24	Reactions of aldehydes and ketones with mechanism	Recognize the general methods of preparation of aldehydes, ketones, carboxylic acids and their derivatives and skill development to analyse	Lecture	1315.4	Mid Term II End Term
25	Reactions of aldehydes and ketones with mechanism	Recognize the general methods of preparation of aldehydes, ketones, carboxylic acids and their derivatives and skill development to analyse	Lecture	1315.4	Mid Term II End Term
26	Reactions of aldehydes and ketones with mechanism	Recognize the general methods of preparation of aldehydes, ketones, carboxylic acids and their derivatives and skill development to analyse	Lecture	1315.4	Mid Term II End Term
27	Reactions of aldehydes and ketones with mechanism	Recognize the general methods of preparation of aldehydes, ketones, carboxylic acids and their derivatives and skill development to analyse	Lecture	1315.4	Mid Term II End Term
28	Introduction to α, β- unsaturated aldehydes and ketones	Recognize the general methods of preparation of aldehydes, ketones, carboxylic acids and their derivatives and skill development to analyse	Lecture	1315.4	Mid Term II End Term
29	Synthesis of α, β- unsaturated aldehydes and ketones	Recognize the general methods of preparation of aldehydes, ketones, carboxylic acids and their derivatives and skill development to analyse	Lecture	1315.4	Mid Term II End Term

30	Physical properties of α, β- unsaturated aldehydes and ketones	Recognize the general methods of preparation of aldehydes, ketones, carboxylic acids and their derivatives and skill development to analyse	Lecture	1315.4	Mid Term II End Term
31	Chemical properties of α, β-unsaturated aldehydes and ketones	Recognize the general methods of preparation of aldehydes, ketones, carboxylic acids and their derivatives and skill development to analyse	Lecture	1315.4	Mid Term II End Term
32	Chemical properties of α, β-unsaturated aldehydes and ketones	Recognize the general methods of preparation of aldehydes, ketones, carboxylic acids and their derivatives and skill development to analyse	Lecture	1315.4	NA
33	Chemical properties of α, β-unsaturated aldehydes and ketones	Recognize the general methods of preparation of aldehydes, ketones, carboxylic acids and their derivatives and skill development to analyse	Lecture	1315.4	End Term
34	Nomenclature, structure and bonding, physical properties of a carboxylic acids	Recall the different types of effects and their effect on relative strength of carboxylic acids and relative stability of acyl derivatives	Lecture	1315.5	End Term
35	Acidity of carboxylic acids	Recall the different types of effects and their effect on relative strength of carboxylic acids and relative stability of acyl derivatives	Lecture	1315.5	End Term
36	Revision Effects of substituents on acid strength	Recall the different types of effects and their effect on relative strength of carboxylic acids and relative stability of acyl derivatives	Lecture	1315.5	End Term

37	Preparation of carboxylic	Recall the different types	Lecture	1315.5	End Term
	acids	of effects and their effect			
		on relative strength of			
		carboxylic acids and			
		relative stability of acyl			
		derivatives			
38	Preparation of carboxylic	Recall the different types	Lecture	1315.5	End Term
	acids	of effects and their effect			
		on relative strength of			
		carboxylic acids and			
		relative stability of acyl			
		derivatives			
39	Reactions of carboxylic	Recall the different types	Lecture	1315.5	End Term
	acids	of effects and their effect			
		on relative strength of			
		carboxylic acids and			
		relative stability of acyl			
		derivatives			
40	Reactions of carboxylic	Recall the different types	Lecture	1315.5	End lerm
	acids	of effects and their effect			
		on relative strength of			
		carboxylic acids and			
		relative stability of acyl			
41		Derivatives			End Tanna
41	Reactions of carboxylic	of offects and their offect		1313.5	End Term
	acids	on relative strength of			
		carboxylic acids and			
		relative stability of acid			
		derivatives			
42	Structure and	Recall the different types	Lecture	1315.5	End Term
	nomenclature of acid	of effects and their effect			
	ablaridas	on relative strength of			
	chiorides	carboxylic acids and			
		relative stability of acyl			
		derivatives			
43	Structure and	Recall the different types	Lecture	1315.5	End Term
	nomenclature of acid	of effects and their effect			
	chlorides	on relative strength of			
		carboxylic acids and			
		relative stability of acyl			
		derivatives			
44	Esters, amides (urea) and	Recall the different types	Lecture	1315.5	End Term
	acid anhydrides	of effects and their effect			

		on relative strength of			
		carboxylic acids and			
		relative stability of acyl			
		derivatives			
45	Esters, amides (urea) and	Recall the different types	Lecture	1315.5	End Term
	acid anhydrides	of effects and their effect			
	-	on relative strength of			
		carboxylic acids and			
		relative stability of acyl			
		derivatives			
46	Relative stability of acyl	Recall the different types	Lecture	1315.5	End Term
	derivatives	of effects and their effect			
		on relative strength of			
		carboxylic acids and			
		relative stability of acyl			
		derivatives			
47	Relative stability of acyl	Recall the different types	Lecture	3 5.5	End Term
	derivatives	of effects and their effect			
		on relative strength of			
		carboxylic acids and			
		relative stability of acyl			
		derivatives			
48	Revision	Interpret the enantiomeric	Interactive/Self study	1315.1	End Term
		and diastereomeric			
		relationship and illustrate			
		application of the			
		stereochemical principles			
		to the structures and			
		functions of acyclic and			
		cyclic molecules			
49	Revision	Elaborate the effect of	Interactive/Self study	1315.2	End Term
		conformation on reactivity			
50	Revision	Explain the general	Interactive/Self study	1315.3	NA
		characteristics and			
		methods of preparation of			
		free radicals and			
		nucleophiles			
51	Revision	Recognize the general	Interactive/Self study	1315.4	NA
		methods of preparation of			
		aldehydes, ketones,			
		carboxylic acids and their			
		derivatives and skill			
		development to analyse			

52	Revision	Recall the different types	Interactive/Self study	1315.5	NA
		of effects and their effect			
		on relative strength of			
		carboxylic acids and			
		relative stability of acyl			
		derivatives			

2. Course Articulation Matrix: (Mapping of COs with POs)

со	STATEMENT		CORRELATION WITH PROGRAM OUTCOMES										CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7				PSO 1	PSO 2	PSO 3	
CY 1316.1	Interpret the enantiomeric and diastereomeric relationship and illustrate application of the stereochemical principles to the structures and functions of acyclic and cyclic molecules	3			T			3				3	2		
CY 1316.2	Elaborate the effect of conformation on reactivity	3						3				3	2	3	
CY 1316.3	Explain the general characteristics and methods of preparation of free radicals and nucleophiles	3						3				3	2	2	
CY 1316.4	Recognize the general methods of preparation of aldehydes, ketones, carboxylic acids and their derivatives and skill development to analyse	3						3				3	2	1	
CY 1316.5	Recall the different types of effects and their effect on relative strength of carboxylic acids and relative stability of acyl derivatives	3						3				3	2	1	

I- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

3. Course Outcome Attainment Level Matrix:

со	STATEMENT		ATTAINMENT OF PROGRAM OUTCOMES THRESHOLD VALUE: 40%													C
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
AU 1492.1	Course Outcome statement															
AU 1492.2	Course Outcome statement															
AU 1492.3	Course Outcome statement															
AU 1492.4	Course Outcome statement															
AU 1492.5	Course Outcome statement															

0-No Attainment; 1- Low Attainment; 2- Moderate Attainment; 3- Substantial Attainment



School of Basic Sciences

Department of Chemistry Course Hand-out

Physical Chemistry-III | CY 1316 | 4 Credits | 3 | 0 4

Session: Jul 18 – Nov 18 | Faculty: Praveen Kumar Surolia | Class: Third Semester (B Sc Chemistry (Hons))

A. Introduction: This course has been designed as a core course for the B Sc Chemistry (Hons) programme, to provide an insight on some topics of Physical Chemistry. It is an essential component of entire curriculum of the programme. It offers theoretical knowledge of the some topics and as well increases analytical thinking of the students.

B. Course Outcomes: At the end of the course, students will be able to

[1316.1]. Discuss kinetic theory of gases and transport properties

[1316.2]. Interpret chemical kinetics of chemical reactions and its impact on reaction mechanism

- [1316.3]. Elaborate conductance nature of electrolytic solution
- [1316.4]. Explain dynamic electrochemical processes and skill development to analyse it
- [1316.5]. Illustrate thermodynamic of diffusion

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

PO1. Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.

PO2 .Effective Communication: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.

PO3. Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.

PO4. Effective Citizenship: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

PO5. Ethics: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.

PO6. Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.

PO7. Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes

PSO1. Recognize and apply the fundamental concepts of chemistry and their applications.

PSO2. Employ critical thinking and scientific inquiry in the interpretation of theoretical knowledge at a level suitable to succeed at an entry-level position in chemical industry or a post graduate chemistry program.

PSO3. Understand the applications of chemical sciences in the areas of organic synthesis, synthesis of materials, corrosion inhibition, environment sustainability etc.

D. Assessment Plan:

Criteria	Description	Maximum Marks
	Sessional Exam I	20
Internal Assessment	Sessional Exam II	20
(Summative)	In class Quizzes and Assignments ,	10
	Activity feedbacks (Accumulated and	
	Averaged)	
End Term Exam	End Term Exam	50
(Summative)		
	Total	100
Attendance	A minimum of 75% Attendance is requir	red to be maintained by a student to be
(Formative)	qualified for taking up the End Semest	er examination. The allowance of 25%
	includes all types of leaves including medi	cal leaves.
Homework/ Home Assignment/	There are situations where a student may	have to work in home, especially before
Activity Assignment	a flipped classroom. Although these work	s are not graded with marks. However, a
(Formative)	student is expected to participate and per	form these assignments with full zeal since
	the activity/ flipped classroom participatio will be awarded.	n by a student will be assessed and marks

E. SYLLABUS

Kinetic theory of gases and transport properties: Kinetic molecular theory of gases, kinetic energy and temperature, distribution of molecular speeds in an ideal gas, distribution in one dimension, distribution of speeds in three dimensions, derivation of Maxwell-Boltzmann distribution law, thermal conductivity, kinetic theory of thermal conductivity in gases; Thermodynamics of diffusion: Thermodynamic view of diffusion, relation between transport properties, Einstein relation, Nernst-Einstein relation, Stoke's Einstein relation; Equilibrium Electrochemistry: Transport of ions in solution, conductivity, Kohlrausch's law, Ostwald dilution law, mobilities of ions, transport number and its measurement, arrhenius theory of Conductivity, Debye-Huckel-Onsager theory of conductivity; Dynamic Electrochemistry: Processes at electrodes, double layer at the interface, non-equilibrium electrode potentials, over potential, derivation of Butler-Volmer equation, Tafel plot, applications of dynamic electrochemistry; Chemical Kinetics: Rate of reaction, rate constant and rate laws, the order of reaction, first, second and third and zero order reactions, halflives; determination of reaction order, temperature dependence of reaction rates, reaction rate-determining approximation, mechanism. step steady-state approximation, explosive/branched chain reactions, catalysis, homogeneous catalysis, autocatalysis, oscillation reactions, bistability, enzyme catalysis, heterogeneous catalysis.

F. TEXT BOOKS

- 1. P. Atkins and J. De Paula, Atkins' Physical Chemistry, Oxford University Press, 2011.
- 2. P. C. Rakshit, *Physical Chemistry*, Sarat Book Distributors, 2004.
- 3. T. Engel and P. Reid, *Physical Chemistry*, Pearson India, 2013.

REFERENCE BOOKS

- 1. G. W. Castellan, Physical Chemistry, Narosa Publishing House, 2004.
- 2. G. M. Barrow, Physical Chemistry, McGraw-Hill International, 1973.
- 3. R. J. Silbey, R. A. Albert and M. G. Bawendi, *Physical Chemistry*, Wiley India, 2006.

I. Lecture Plan:

Lecture	Topics	Session Outcome	Mode of Delivery	Corresponding CO	Mode of Assessing the
No.	Kinetic theory of gases and	Understanding the concepts	Locturo	13161	Mid Torm I
	transport properties: Kinetic molecular theory of gases, kinetic energy and temperature	of kinetic molecular theory of gases and its temperature dependence		1310.1	End Term
2	Distribution of molecular speeds in an ideal gas	Interpret distribution of molecular speeds in ideal gas	Lecture	1316.1	Mid Term I End Term
3	Distribution in one dimension	Interpret distribution of molecular speeds in one dimension	Lecture	1316.1	Mid Term I End Term
4	Distribution of speeds in three dimensions	Interpret distribution of molecular speeds in three dimension	Lecture	1316.1	Mid Term I End Term
5	Derivation of Maxwell-Boltzmann distribution law	Construct Maxwell- Boltzmann distribution law of ideal gas molecules	Lecture	1316.1	Mid Term I End Term
6	Thermal conductivity	Explain the thermal conductivity of ideal gas molecule	Lecture	1316.1	Mid Term I End Term
7	Kinetic theory of thermal conductivity in gases	Understand and elaborate the kinetics of thermal conductivity	Lecture	1316.1	Mid Term I End Term
8	Numerical problems	NA	Interactive/Self study	1316.1	Mid Term I End Term Assignment
9	Numerical problems	NA	Interactive/Self study	1316.1	Mid Term I End Term Assignment
10	Thermodynamics of diffusion : Thermodynamic view of diffusion	Understand the diffusion process and its thermodynamic study	Lecture	1316.5	Mid Term I End Term
11	Relation between transport properties	Explore the relation between transport properties	Lecture	1316.5	Mid Term I End Term
12	Einstein relation	Explain the Einstein relation	Lecture	1316.5	Mid Term I End Term
13	Nernst-Einstein relation	Explain the Nernst-Einstein relation	Lecture	1316.5	Mid Term I End Term
14	Stoke's Einstein relation	Explain the Stoke's Einstein relation	Lecture	1316.5	Mid Term I End Term

15	Numerical and theoretical problems	NA	Lecture	1316.5	Mid Term I End Term
16	Revision Class	NA	Interactive/Self study	1316.5	NA
17	Equilibrium Electrochemistry: Transport of ions in solution, conductivity	Recall the conductivity and transport of ions	Lecture	1316.3	Mid Term II End Term
18	Kohlrausch's law, Ostwald dilution law	hlrausch's law, Ostwald dilution law Elaborate the Kohlrausch's law, Ostwald dilution law		1316.3	Mid Term II End Term
19	Mobility of ions, transport number and its measurement	Evaluate Mobility of ions, transport number and its measurement	Lecture	1316.3	Mid Term II End Term
20	Arrhenius theory of Conductivity	Solve the conductivity phenomena using Arrhenius theory	Lecture	1316.3	Mid Term II End Term
21	Debye-Huckel-Onsager theory of conductivity	Explain Debye-Huckel- Onsager theory of conductivity	Lecture	1316.3	Mid Term II End Term
22	Numerical problems	NA	Lecture	1316.3	Mid Term II End Term Assignment
23	Numerical problems	NA	Lecture	1316.3	Mid Term II End Term Assignment
24	Dynamic Electrochemistry: Processes at electrodes, double layer at the interface	Understand the various processes and charge structure at electrode	Lecture	1316.4	Mid Term II End Term
25	25 non-equilibrium electrode potentials Understand the electrode potential		Lecture	1316.4	Mid Term II End Term
26	over potential	Explain over potential concept	Lecture	1316.4	Mid Term II End Term
27	derivation of Butler-Volmer equation	Formulate the Butler-Volmer equation	Lecture	1316.4	Mid Term II End Term
28	Tafel plot	Understand and design the Tafel plot	Lecture	1316.4	Mid Term II End Term
29	Applications of dynamic electrochemistry	Solve and use of dynamic electrochemistry	Lecture	1316.4	Mid Term II End Term
30	Numerical problems	NA	Interactive/Self study	1316.4	Mid Term II End Term

					Assignment
31	Numerical problems	NA	Interactive/Self study	1316.4	Mid Term II
			,		End Term
					Assignment
32	Revision class	ΝΔ	Interactive/Self study	1316.4	NΔ
52			interactive/Sell Study	1310.4	
33	Chemical Kinetics: Rate of reaction,	Recall the basics of chemical	Lecture	1316.2	End Term
	rate constant and rate laws, the order	kinetics			
	of reaction				
34	first, second order reactions	Construct the rate law of first	Lecture	1316.2	End Term
		and second order chemical			_
		reactions and their examples			
35	third and zero order reactions half-lives	Construct the rate law of	Lecture	13162	End Term
		third and zero order chemical		1010.2	
		reactions and their examples			
36	determination of reaction order	Discuss the methods of	Lecture	1316.2	End Term
50	determination of reaction of def	reaction order determination	Lecture	1510.2	
27	town own do and on a of warding	reaction of der determination	Lastura	1214.2	Fud Tanna
37	temperature dependence of reaction	inspect the effect of	Lecture	1316.2	Endlerm
	rates	temperature on reaction			
		rates			
38	reaction mechanism, rate-determining	Understand the reaction	Lecture	1316.2	End lerm
	step approximation	mechanism and rate			
		determination step			
		approximation			
39	steady-state approximation	Discuss the steady-state	Lecture	1316.2	End Term
		approximation			
40	steady-state approximation	Discuss the steady-state	Lecture	1316.2	End Term
		approximation			
41	Numerical problems	NA		1316.2	End Term
			-		
42	explosive/branched chain reactions	Discuss complex chain and	Lecture	1316.2	End Term
		branch reactions			
43	catalysis, homogeneous catalysis	Understand and classify the	Lecture	1316.2	End Term
		catalysis and homogeneous			
		catalysis			
44	autocatalysis, oscillation reactions	Explain the autocatalysis	Lecture	1316.2	End Term
		phenomena and kinetics of			
		oscillatory reactions			
45	bistability, enzyme catalysis	Understanding of bistability	Lecture	1316.2	End Term
		and kinetics of enzyme			
		catalysis			
46	heterogeneous catalysis	Explain the heterogeneous	Lecture	1316.2	End Term
		catalysis			-
			1		

47	heterogeneous catalysis	Explain the heterogeneous	Lecture	1316.2	End Term
		catalysis			
48	Numerical problems	NA	Interactive/Self study	1316.2	End Term
					Assignment
49	Numerical problems	NA	Interactive/Self study	1316.2	End Term
					Assignment
50	Revision class	NA	Interactive/Self study	1316.2	NA
51	Revision Class	NA	Interactive/Self study	1316.5	NA
52	Revision Class	NA	Interactive/Self study	1316.5	NA

2. Course Articulation Matrix: (Mapping of COs with POs)

со	STATEMENT		CORRELATION WITH PROGRAM OUTCOMES								CORRELATION WITH PROGRAM SPECIFIC OUTCOMES			
		PO 1	PO 2	PO 3	РО 4	PO 5	PO 6	PO 7				PSO 1	PSO 2	PSO 3
CY 1316.1	Discuss kinetic theory of gases and transport properties	3						3				3	2	
CY 1316.2	Interpret chemical kinetics of chemical reactions and its impact on reaction mechanism	3						3				3	2	3
CY 1316.3	Elaborate conductance nature of electrolytic solution	3						3				3	2	2
CY 1316.4	Explain dynamic electrochemical processes and skill development to analyse it	3						3				3	2	1
CY 1316.5	Illustrate about thermodynamic of diffusion	3						3				3	2	1

I- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

3. Course Outcome Attainment Level Matrix:

со	STATEMENT		ATTAINMENT OF PROGRAM OUTCOMES THRESHOLD VALUE: 40%									ATTAINMENT OF PROGRAM SPECIFIC OUTCOMES				
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
AU 1492.1	Course Outcome statement															
AU 1492.2	Course Outcome statement															
AU 1492.3	Course Outcome statement															
AU 1492.4	Course Outcome statement															
AU 1492.5	Course Outcome statement															

0-No Attainment; 1- Low Attainment; 2- Moderate Attainment; 3- Substantial Attainment



School of Basic Sciences

Department of Chemistry Course Hand-out

Computer Application in Chemistry | CY1332 | 4 Credits | 3 | 0 4

Session: Jul 18 - Nov 18 | Coordinator: Dr. Susruta Samanta | Class: B.Sc. (III Semester)

A. Introduction: This course is offered by Dept. of Chemistry as a core subject in the 3rd semester of the B.Sc. Chemistry Honours programme, with an emphasis on fundamental understanding of computers and its application to solve problems in chemistry. The course explains the fundamentals of computation, and mathematical concepts. This covers data handling, plotting, fitting, variables, integration, differentiation, and statistical analysis. The course also grows understanding of simple programming and scripting languages. Students are expected to have basic background knowledge of chemistry and mathematics for this course.

B. Course Objectives: At the end of the course, students will be able to/posses

- [1332.1]. Acquire skills of chemical data handling in a large scale.
- **[1332.2].** Effective use and handling of data analysis software.
- [1332.3]. Interpret experimental data using plotting tools.
- [1332.4]. Formulate scripts and programs to manipulate, extract and interpret data.
- [1332.5]. Enhance employability as a data scientist.

C. Program Outcomes and Program Specific Outcomes

- **[PO.1].** Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.
- **[PO.2].** Effective Communication: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.
- **[PO.3].** Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.
- **[PO.4].** Effective Citizenship: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.
- **[PO.5].** Ethics: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.
- **[PO.6].** Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.
- **[PO.7].** Self-directed and Life-long Learning: Acquire the ability to engage in independent and lifelong learning in the broadest context socio-technological changes

[PSO.I]. Recognize the fundamental concepts of chemistry and their applications.

[PSO.2]. Employ critical thinking and scientific inquiry in the interpretation of theoretical knowledge at a level suitable for an entry level position in the chemical industry or a post graduate chemistry program.

[PSO.3]. Conceptualize and apply the ideas of chemical sciences in the areas of organic synthesis, synthesis of materials, corrosion inhibition, environment sustainability etc.

D. Assessment Plan:

Criteria	Description	Maximum Marks						
	Constant Evaluation	20						
Internal Assessment	Daily Viva	10						
(Summative)	Quiz tests and assignments	30						
	(Accumulated and Averaged)							
End Term Exam	End Term Exam (Closed Book)	40						
(Summative)								
	Total	100						
Attendance	A minimum of 75% Attendance is requir	red to be maintained by a student						
(Formative)	to be qualified for taking up the End Sem	ester examination. The allowance						
	of 25% includes all types of leaves includi	ng medical leaves.						
Homework/ Home Assignment/	There are situations where a studen	t may have to work in home,						
Activity Assignment	especially before a flipped classroom. S	ome of these works are graded						
(Formative)	with marks. A student is expected to participate and perform these							
	assignments with full zeal since the activity/ flipped classroom participation							
	by a student will be assessed and marks w	vill be awarded.						

E. Syllabus

Computer programming: Constants, variables, bits, bytes, binary and ASCII formats, arithmetic expressions, hierarchy of operations, inbuilt functions, elements of the BASIC language, BASIC keywords and commands, logical and relative operators, strings and graphics, Compiled versus interpreted languages. Debugging. Simple programs using these concepts. Conceptual background of molecular modelling, potential energy surfaces, elementary ideas of molecular mechanics and practical MO methods; Use of computational tools to plot and analyze data.

F. References

- 1. K. L. Kapoor, A Textbook of Physical Chemistry Computational Aspects in Physical Chemistry Vol. 6, McGrawHill Education, 2015.
- 2. B. R. Puri, L. R. Sharma & M. S. Pathania, Principles of Physical Chemistry, Vishal Publication, 2010.
- 3. P. Cornell, Accessing and Analyzing Data with Microsoft Excel, Microsoft Press, 2003.
- 4. T. Sheetal, N. Kumar, Python Programming: A Modular Approach, Pearson, 2017.
- 5. H. P. Langtangen, Python Scripting for Computational Science, Springer, 2009.

Lec. No	Topics	Session Outcome	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
1.	Introduction to the course, introduction to computers	To acquaint and clear teacher's expectations and understand students' expectations.	Lecture, activity	1332.1-5	None
2.	Fundamentals of computer applications	Conceptualize and apply computers for science	Hands on activity	1332.1-5	Mid Term End Term
3.	Fundamental mathematical concepts	Explain basics of mathematics necessary for computation	Hands on activity	1332.1-5	Mid Term End Term
4.	Introduction to data analysis using excel	Analyse large data using excel	Hands on activity	332. -2	Mid Term End Term
5.	Use of functions, formula in excel	Manipulate data using functions and formula in excel	Hands on activity	1332.1-2	Mid Term End Term
6.	Use of pivot tables in excel	Manipulate data using functions and formula in excel	Hands on activity	1332.1-2	Mid Term End Term

I Lecture Plan:

7.	Fundamentals of data visualization	Plot large-scale chemical data	Hands on activity	1332.3	Mid Term End Term
8.	Plotting of data using excel, gnuplot, xmgrace	Plot large-scale chemical data and interpret them	Hands on activity	1332.3	Mid Term End Term
9.	Data manipulation, fitting using plotting software.	Plot large-scale chemical data and interpret them	Hands on activity	1332.3	End Term
10.	Introduction to programming	Conceptualize the basics of python programming	Hands on activity	1332.3	End Term
11.	Variables and expressions	Data manipulation using variables	Hands on activity	1332.4-5	End Term
12.	Conditional codes	Use conditions to manipulate data	Hands on activity	1332.4-5	End Term
13.	Functions	Use functions to manipulate data	Hands on activity	1332.4-5	End Term
14.	Loops and iterations	Use loops to manipulate data	Hands on activity	1332.4-5	End Term
15.	Analysis of biochemical data	Extract and analyse biochemical data	Hands on activity	1332.5	End Term
16.	Revision	Summarize application of computer in chemistry	Hands on activity	1332.1-5	Mid Term End Term

Course Articulation Matrix: (Mapping of COs with POs)

со	STATEMENT	CORRELATION OUTCOMES			WITH PROGRAM			CORRELATION WITH PROGRAM SPECIFIC OUTCOMES			
		POI	PO2	PO3	PO4	PO5	PO6	PO7	PSOI	PSO2	PSO3
CY 1332.1	Acquire skills of chemical data handling in a large scale	3						3	I	3	
CY 1332.2	Effective use and handling of data analysis software	3						3	2	2	
CY 1332.3	Interpret experimental data using plotting tools	3						3	2	3	
CY 1332.4	Formulate scripts and programs to manipulate, extract and interpret data	3		1				3	I	I	
CY 1332.5	Enhance employability as a data scientist	3	I					3	3	3	I

I- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation



School of Basic Sciences Department of Mathematics & Statistics Course Hand – Out Differential Equations | MA1311| 4 Credits | 3 1 0 4 Session: July. 18 – Dec 18 | Faculty: Dr. Anamika Jain | Class: B. Sc. III Sem.

A. Introduction:-

A differential equation is an equation for a function that relates the values of the function to the values of its derivatives. An ordinary differential equation (ode) is a differential equation for a function of a single variable, e.g., x(t), while a partial differential equation (pde) is a differential equation for a function of several variables, e.g., v(x, y, z, t). An ode contains ordinary derivatives and a pde contains partial derivatives. Typically, pde's are much harder to solve than ode's.

Course Outcomes: At the end of the course, students will be able to

- **1311.1** Recognise the concept of linear differential equations in real life problems develop employability skills.
- **1311.2** Describe the framework of nonlinear differential equations.
- **1311.3** Understand conceptual framework of higher differential equations.
- **1311.4** Evaluate the impact of development in different fields to apply the applications of differential equations.

B. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

- [PO1]. Critical thinking: Critically interpret data, write reports and apply the basics of evidence.
- **[PO2]**. Effective Communication: Communicate effectively by writing, connecting people, ideas, books, media and technology.
- **[PO3]**. Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.
- **[PO4].** Effective Citizenship: Demonstrate empathetic social concern and equity centered national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.
- [PO5]. Ethics: Apply ethical principles and commit to professional ethics and responsibilities.
- **[PO6].** Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.
- **[PO7].** Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context socio technological changes
- [PSO.1] To understand the basic principles and apply these principles both in simple exercises

and in more complex problems of advanced study.

[PSO.2] To Understand and apply the fundamental concepts of Sciences, employ critical thinking and scientific queries at a suitable level to get success in Professional domain and / or Higher Studies.

[PSO.3] To understand the Mathematical applications in science & Technology.

C. Assessment Plan:-

Criteria	Description	Maximum Marks						
	Sessional Exam I (Close Book)	20						
Internal Assessment	Sessional Exam II (Close Book)	20						
(Summative)	In class Quizzes and 10							
	Assignments, Activity							
	feedbacks (Accumulated and							
	Averaged)							
End Term Exam	End Term Exam (Closed Book)	50						
(Summative)								
	Total	100						
Attendance	A minimum of 75% Attendance i	s required to be maintained by a						
(Formative)	student to be qualified for taking u	p the End Semester examination.						
	The allowance of 25% includes all	types of leaves including medical						
	leaves.							
Make up Assignments	Students who missed the classes of	or getting lass marks, the remedy						
(Formative)	classes has to be taken.							
Homework/ Home Assignment/	Student is expected to participate and perform these assignments							
Activity Assignment	with full zeal since the activity/ flipped classroom participation by a							
(Formative)	student will be assessed and marks	will be awarded.						

Equations of first order and first degree: Variables separable, reducible to variables separable form, homogeneous form, reducible to homogeneous form, linear equations, reducible to linear form, exact equations, reducible to exact form. Equations of first order but not of first degree: Equations solvable for x, y, p. Clairaut's form, Lagrange's form and singular solutions. Orthogonal trajectories. Higher order Linear differential equations with constant coefficients. Homogeneous linear differential equations. Simultaneous differential equations. Linear differential equation of second order with variable coefficients: One part of complementary function known, reduction to normal form, change of independent variable, solution by means of operational factor and method of variation of parameters.

Text Books:

- 1. G. F. Simmons, Differential Equations, Tata McGraw-Hill Education, 2006.
- 2. M. D. Raisinghania, Ordinary and Partial Differential Equations, S. Chand & Co., 2014.
- 3. S. L. Ross, Differential Equations, Wiley, 2013.

Reference Books:

- 1. E. A. Coddington, Theory of Ordinary Differential Equations, McGraw Hill, 2014.
- 2. J. L. Bansal, H. S. Dhami, Differential Equation, Vol-1, Jaipur Pub. House, 2012.
- 3. Rukmangadachari, Differential Equations, Pearson, 2012.
- 4. R. J. T. Bell, Elementary Treatise on Coordinary Geometry of Three Dimensions, MacMillan India Ltd. 1994.
- 5. P. K. Jain and Khalil Ahmad: A Textbook of Analytical Geometry of Three Dimensions, Wiley Eastern Ltd. 1999.

D. Lecture Plan:-

Lecture	Cumulative	Description of the syllabus
1	1	Introductory part of the differential equations.
2	3	First order and first degree differential equations, variable separable form and homogeneous form
3	9	Reducible to homogeneous form, Linear differential equations and reducible to linear differential equations
4	10	Tutorial Class-I
		Assignment-I
3	13	Exact and reducible to exam form
1	14	Tutorial Class-II
		Assignment-II
6	20	Higher order Linear differential equations with constant coefficient
2	22	Tutorial Class-III
		First Sessional
3	25	Solution of simple simultaneous linear differential equations.
1	26	Tutorial Class-III
4	30	Second order linear differential equations with variable coefficient
2	32	Tutorial Class-IV
		Assignment-III
5	37	First order higher degree equations solvable for x, y, p. Clairaut's form and singular solutions.
2	39	Tutorial Class-V
		Second Sessional
2	41	Orthogonal trajectories and problems
2	43	Tutorial Class-VI
		Assignment-IV
2	45	Application based problems of first order and first degree differential equations

2	47	Application based problems of higher order linear differential equations with constant coefficients
2	49	Application based problems of second order linear differential equations with variable coefficients
,		Assignment-V

E. Course Articulation Matrix: (Mapping of COs with POs and PSOs):-

CO	STATEMENT	C	CORRELATION WITH PROGRAM OUTCOME							CORRELATIO N WITH PROGRAM SPECIFIC OUTCOME		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PS O 1	PS O 2	PS O 3	
MA1311. 1	Recognise the concept of linear differential equations in real life problems develop employability skills.	1			3			3		2		
MA1311. 2	Describe the framework of nonlinear differential equations.		2	3		1					3	
MA1311. 3	Understand conceptual framework of higher differential equations.	2		2			1		2			
MA1311. 4	Evaluate the impact of development in different fields to apply the applications of differential equations.		2		2							

1-

1:-Low Correlation; 2:-Moderate Correlation; 3:- Substantial Correlation

CO	STATEMENT	ATTAINMENT OF PROGRAM					Α	ATTAINMENT OF				
				OUT	COMI	ES		Р	PROGRAM SPECIFIC			
		Т	THRESHOLD VALUE: 40%					0	OUTCOMES			
		PO	PO	PO	PO	PO	PO	PO	PS	PS	PS	PS
		1	2	3	4	5	6	7	01	O 2	03	04
MA1311.	Recognise the concept of											
1	linear differential equations											
	in real life problems											
	develop employability											
	skills.											
MA1311.	Describe the framework of											
2	nonlinear differential											
	equations.											
MA1311.	Understand conceptual											
3	framework of higher											
	differential equations.											
MA1311.	Evaluate the impact of											
4	development in different											
	fields to apply the											
	applications of differential											
	equations.											

F. Course Outcome Attainment Level Matrix:-

0-No Attainment; 1- Low Attainment; 2- Moderate Attainment; 3- Substantial Attainment



School of Basic Sciences

Department of Mathematics & Statistics Course Hand-out

Solid Geometry MA 1319 | 4 Credits | 3 | 0 4

Session: July -Nov. 2018 | Faculty: Dr. Sunil Joshi Class: B. Sc (Pass Course)

- A. Introduction: This course is offered by Dept. of Mathematics and Statistics for Mathematics (Pass Course) students, targeting students who wish to pursue research & development in industries or higher studies in field of Mathematics and Engineering. Offers in depth knowledge of Conics, sphere, cone, cylinder, conicoids, Ellipsoid, paraboloid, Generating lines, reduction of second degree equations. Students are expected to have background knowledge of 2D coordinate geometry and partial part of 3D geometry that includes points, line and Plane for a better learning.
- **B. Course Outcomes:** At the end of the course, students will be able to

[1319.1] Understand and analyse conics and their related properties to apply in real world problems.

[1319.2] Understand the concepts of sphere, cone and cylinder to apply in real world problems.

[1319.3] Understand the concepts of conicoid and analyse the related problems.

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.

Effective Communication: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.

Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.

Effective Citizenship: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

Ethics: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.

Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.

Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-

long learning in the broadest context socio-technological changes

[PSO.1] To understand the basic principles and apply these principles both in simple exercises and in more complex problems of advanced study.

[PSO2] To Understand and apply the fundamental concepts of Sciences, employ critical thinking and scientific queries at a suitable level to get success in Professional domain and / or Higher Studies.

[PSO.3] To understand the Mathematical applications in science & Technology.

Criteria	Description	Maximum Marks							
	Sessional Exam I (Open Book)	20							
Internal Assessment	Sessional Exam II (Open Book)	20							
(Summative)	In class Quizzes and	10							
	Assignments , Activity								
	feedbacks (Accumulated and								
	Averaged)								
End Term Exam	End Term Exam (Open Book)	50							
(Summative)									
	Total	100							
Attendance	A minimum of 75% Attendance is required to be maintained by a								
(Formative)	student to be qualified for taking up the End Semester								
	examination. The allowance of 2	25% includes all types of leaves							
	including medical leaves.								
Make up Assignments	Students who misses a class will	have to report to the teacher							
(Formative)	about the absence. A makeup as	signment on the topic taught on							
	the day of absence will be given v	which has to be submitted within							
	a week from the date of absence	. No extensions will be given on							
	this. The attendance for that pa	articular day of absence will be							
	marked blank, so that the studer	nt is not accounted for absence.							
	These assignments are limited to	a maximum of 5 throughout the							
	entire semester.								
Homework/ Home	There are situations where a stud	dent may have to work in home,							
Assignment/ Activity	especially before a flipped classro	oom. Although these works are							
Assignment	not graded with marks. Howe	ver, a student is expected to							
(Formative)	participate and perform these as	signments with full zeal since the							

D. Assessment Plan:

activity/	flipped	classroom	participation	by	а	student	will	be
assessed	and ma	rks will be a	warded.	-				

E. SYLLABUS

MA 1319 Solid Geometry

Conics: Tracing of conics, Tangent at any point to the conic, Chord of contact, Pole of line to the conic, Director circle of conic, System of conics, Confocal conics, Polar equation of a conic, tangent and normal to the conic.

Sphere: Equation of sphere, Tangent plane, Plane of contact and polar plane, Intersection of two spheres, radical plane, Coaxial spheres, Conjugate systems. **Cone:** Equation of a cone, Intersection of cone with a plane and a line, Enveloping cone, Right circular cone. **Cylinder:** Right circular cylinder and enveloping cylinder.

Central Conicoids: Equation of tangent plane, Director sphere, Normal to the conicoids, Polar plane of a point, Enveloping cone of a coincoid, Enveloping cylinder of a coincoid, Ellipsoids, Hyperboloid of one and two sheet.

Paraboloids: Circular section, Plane sections of conicoids. Generating lines. Confocal conicoids. Reduction of second degree equations.

F. Text Books:

1. Shanti Narayan, P. K. Mittal, Analytical Geometry, S. Chand, 2010.

2. R. J. T. Bell, Elementary Treatise on Coordinary Geometry of Three Dimensions, MacMillan India Ltd. 1994.

3. P. K. Jain and Khalil Ahmad: A Textbook of Analytical Geometry of Three Dimensions, Wiley Eastern Ltd. 1999

G. Reference Books:

1. S. L. Loney, Elements of Coordinate Geometry, Scholarly Publishing Office, University of Michigan Library, 2005.

2. P.C. Golas, O. P. Tandon, S. L. Bhargava, Analytical Solid Geometry, Jaipur Pub. House, 2008.

H. Lecture Plan:

LEC NO	TOPICS
1	Introduction and Course Hand-out briefing
2	Conics – Introduction
3-4	Tracing of conics, Tangent at any point to the conic
5-6	Chord of contact, Pole of line to the conic
7	Tutorial
8-10	Director circle of conic, System of conics, Confocal conics, Polar equation of a conic

11-13	tangent and normal to the conic.
14	Tutorial
15-18	Equation of sphere, Tangent plane, Plane of contact and polar plane
18-20	Intersection of two spheres, radical plane, Coaxial spheres, Conjugate systems.
20-23	Equation of a cone, Intersection of cone with a plane and a line, Enveloping cone, Right circular cone.
24	Tutorial
25-27	Right circular cylinder and enveloping cylinder
28-29	Central Conicoids, Ellipsoid, Paraboloid, hyperboloid and their tracing
30-33	Equation of tangent plane, Director sphere, Normal to the conicoids, Polar plane of a point,
34	Tutorial
35-36	Enveloping cone of a conicoid, Enveloping cylinder of a conicoid
37-38	Ellipsoids
39-40	Hyperboloid of one and two sheet.
41	Tutorial
42-43	Paraboloids: Circular section, Plane sections of conicoid
44-46	Generating lines. Confocal conicoid.
47-49	Reduction of second degree equations.
50	Tutorial

I. Course Articulation Matrix: (Mapping of COs with POs)

СО	STATEMENT										
		PO	РО	РО	PO	PO	PO	РО	PSO	PSO	PSO
		1	2	3	4	5	6	7	1	2	3
MA 1319.1	Understand and analyse conics and their related properties to apply in real world problems.	2					1		3		
MA 1319.2	Understand the concepts of sphere, cone and cylinder to apply in real world problems.	3		1				2		2	

MA 1319.3	Understand the concepts	2			2			1
	of conicoid and analyse							
	the related problems.							
	_							
			_					

I- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

J. Course Outcome Attainment Level Matrix:

со	STATEMENT								ATTAINMENT OF PROGRAM SPECIFIC OUTCOMES			
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3	PSO4
MA 1319.1	Understand and analyse conics and their related properties to apply in real world problems.											
MA 1319.2	Understand the concepts of sphere, cone and cylinder to apply in real world problems.											
MA 1319.3	Understand the concepts of conicoids and analyse the related problems.											

0-No Attainment; I- Low Attainment; 2- Moderate Attainment; 3- Substantial Attainment



School of Basic Sciences

Department of Biosciences Course Hand-out

Molecular Biology BY 1301 | 3 Credits | 2 | 0 3

Session: 2018-2019 | Faculty: Dr. Singh Abhijeet | Class: III Semester

- A. Introduction: This course is offered by Dept. of Biosciences as a core course in B.Sc. (pass) Biotechnology and, as a subsidiary course in B.Sc. (Hons) Biotechnology Programme targeting students who wish to pursue their career in the research field of Molecular Biology or higher studies in the field of genetic engineering, Recombinant DNA technology. The course offers in depth knowledge of central dogma, structure of DNA, RNA along with amplification of DNA inside cells, synthesis of protein and RNA along with regulation of gene expression. Students are expected to have background knowledge of the different types of nucleic acid and proteins.
- B. Course Outcomes: At the end of the course, students will be able to understand the
 - **[BY 1301.1].** Define the basic of central dogma and understand various biological processes through the investigation of the underlying molecular mechanisms
 - [BY 1301.2]. Understand the chemical and molecular processes that occur in and between cells.
 - **[BY 1301.3].** Apply various molecular techniques related to DNA as genetic material thereby enhancing the skills in molecular biology
 - **[BY 1301.4].** Examine the most significant molecular and cell-based methods used today to expand the employability in the field of molecular biology
 - [BY 1301.5]. Evaluate the mechanism behind copying of DNA with extra fidelity.
 - **[BY 1301.6].** Evaluate the process behind formation of RNA and proteins and to Investigate the molecular mechanisms behind different modes of gene regulation in bacteria

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

- **[PO.I]. Critical Thinking:** Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational and personal) from different perspectives.
- **[PO.2]. Effective Communication:** Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.
- [PO.3]. Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.
- **[PO.4]. Effective Citizenship:** Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.
- **[PO.5]. Ethics:** Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.
- [PO.6]. Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.
- **[PO.7]. Self-directed and Life-long Learning:** Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes.
- **[PSO.1.]** To demonstrate competency in factual content and interpretation of the major biological concept areas of cell and molecular biology, genetics, organismal biology, and evolution and ecology.
- **[PSO.2.]** To demonstrate the ability to identify significant biological research questions, develop research protocols, and properly analyze research questions through the use of the scientific method.
- **[PSO.3.]** Enhance analytical and quantitative skills and demonstrate an understanding of basic computational and statistical techniques in the field of Biotechnology

D. Assessment Plan:

Criteria	Description	Maximum Marks
	Mid Term Exam I – IA I	20
Internal Assessment	Mid Term Exam 2 - IA 2	20
(IA)	CWS Assessment IA 3	10
	10 marks of IA 3 are awarded based on the various	
	assignments, class tests, seminar presentation etc.	
End Term Exam (EX)	End Term Exam – EX I	50
	Total	100

Note A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.

E. SYLLABUS

Nucleic acids transfer genetic information: DNA as the carrier of genetic information, key experiments establishing-the Central Dogma, DNA Double helix, Genetic code. The Structures of DNA and RNA: DNA Structure, Types of DNA, denaturation and renaturation. DNA topology. The Replication of DNA in Prokaryotes and Eukaryotes: general principles- bidirectional replication, Semiconservative, Semi discontinuous. Enzyme involved in DNA replication – DNA polymerases, DNA ligase, Primase, Telomerase and other accessory proteins. Mechanism of Transcription and translation in Prokaryotes and Eukaryotes. Regulation of gene expression, Lac operon model.

F. .TEXT BOOKS

- 1. Singh, B.D. Biotechnology. Kalyani Publishers, New Delhi, India. 2010.
- 2. Gupta, P.K. Text Book of Cell and Molecular Biology, Rastogi Publications, Merrut, 2012.

G. REFERENCE BOOKS

- I Alberts, B., Bray, D., Lewis, J., Raff, M., Roberts K. and Watson, J.D. Molecular Biology of the Cell, Garland Publishing Inc., New York, 2008.
- 2. Karp, G., Cell and Molecular Biology: Concepts and Experiments, John Wiley & Sons, New Delhi, 2008.
- Lodish, H., Berk, A., Zipursky, S.L., Matsudiara, P., Baltimore D and Darnell J. Molecular Cell Biology, WH Freeman & Co. New York, 2013

H. Lecture Plan:

LEC	TOPICS	Session Outcome	Mode of	Corresponding	Mode of assessing the
NO			Delivery	CO	outcome
Ι.	Discussion of lecture plan and syllabi	Understand the course content	Lecture	BY 1301.1	MTE 1
					Quiz
					End Term
2.	Introduction to molecular biology	Understand the basic techniques	Lecture	BY 1301.1	MTE 1
		related to the subject			Quiz
					End Term
3.	Genetics and Biology, molecular structure of	Understand the basic techniques	Lecture	BY 1301.1	Class Test/ Quiz
	nucleic acids	related to the subject			
4.	Tutorial	Recall the basic techniques	Discussion	BY 1301.1	MTE 1
		related to the subject			Quiz/ Class Test
					End Term
5.	Packaging of DNA into chromosomes	Learn the procedure of DNA	Lecture	BY 1301.2	MTE 1
		packaging			Quiz/ Class Test
					End Term
6.	DNA as the genetic material	Learn various experiments	Lecture	BY 1301.4	Class Test &
		related to DNA as heredity			Assignments
7	Classical avagatiments of Hambay Chase Avan	material	T (MTE 1
7.	McLeod etc	related to DNA as heredity	Lecture	DI 1301.4	MIEI Original Classe Teact
		material			Quiz/ Class Test
0	Tutorial	Possil the experiments	Diamatica	PV 1201 4	End Term
0.	Tutonai	Recail the experiments	Discussion		MIEI Original Classe Teact
					Quiz/ Class Test
0	Control dogma and its concept	Learn Molecular Basics of life	Lastana	BX 1301.2	End Term
7.	Central dogina and its concept	Learn Profecular Basics of file	Lecture	DT 1301.2	Class Test α
10	The Structures of DNIA and PNIA	Learn the structure of DNA	Lastana	BX 1301 3	Assignments
10.		Learn the structure of DNA	Lecture	DT 1501.5	MIE2 Oviz/Class Test
					Quiz/ Class Test
	The Structures of DNIA and PNIA	Learn the structure of DNA	T t	BX 1301.3	End Term
			Lecture		$\frac{WIE2}{Owint/Class Test}$
					Quiz/ Class Test
10	Poplication: introduction	Lindorstand DNA duplication	T frank	BX 1301 5	End Term
12.			Lecture		Class Test
10	Poplication: Principle	Learn the structure of DNIA	T (End Term
13.	Replication: Principle	Learn the structure of DINA	Lecture	כווסנו ום	MIE2
					Quiz/ Class Test
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					End Term
14.	Tutorial	Recall DNA duplication	Discussion	BY 1301.5	MTE 2
					Quiz/ Class Test
					End Term
١5.	Replication: Enzymes involved	Understand formation of RNA	Lecture	BY 1301.6	MTE 2
					Debate
					End Term
16.	Replication: uptill termination	Understand formation of RNA	Lecture	BY 1301.6	MTE 2
					Quiz/ Class Test
					End Term
17.	Tutorial	Recall the process	Discussion	BY 1301.6	MTE 2
					Quiz/ Class Test
					End Term
18.	Transcription: introduction	Understand formation of RNA	Lecture	BY 1301.6	Quiz/ Class Test
					End Term
19.	Transcription: Principle	Understand formation of RNA	Lecture	BY 1301.6	MTE 2
					Quiz/ Class Test
					End Term
20.	Tutorial	Recall the process	Discussion	BY 1301.6	MTE 2
					Quiz/ Class Test
					End Term
21.	Transcription: Enzymes involved	Understand formation of RNA in	Lecture	BY 1301.6	End Term
		eukaryotes			Quiz/ Class Test
22.	Transcription: uptill termination	Understand formation of RNA in	Lecture	BY 1301.6	End Term
		eukaryotes			Quiz/ Class Test
23.	Tutorial	Recall the process	Discussion	BY 1301.6	End Term
					Quiz/ Class Test
24.	Translation: introduction	Understand formation of protein	Lecture	BY 1301.6	Class Test
25.	Translation: Principle	Understand formation of protein	Lecture	BY 1301.6	End Term
					Quiz/ Class Test
26.	Tutorial	Recall the process	Discussion	BY 1301.6	End Term
					Quiz/ Class Test

27.	Translation: Enzymes involved	Understand formation of protein	Lecture	BY 1301.6	Class Test
28.	Translation: uptill termination	Understand formation of protein	Lecture	BY 1301.6	End Term Quiz/ Class Test
29.	Tutorial	Recall the process	Discussion	BY 1301.6	End Term Quiz/ Class Test
30.	Structure of gene	Learn Gene Regulation	Lecture	BY 1301.6	Class Test
31.	concept of promoter, regulator, enhancer, operator & structural genes	Learn Gene Regulation	Lecture	BY 1301.6	End Term Quiz/ Class Test
32.	Tutorial	Recall the process	Discussion	BY 1301.6	End Term Quiz/ Class Test
33.	inducible and repressible gene expressions	Learn Gene Regulation	Lecture	BY 1301.6	Class Test
34.	Tutorial	Recall the process	Lecture	BY 1301.6	End Term Quiz/ Class Test
35.	operon concept	Learn Gene Regulation	Discussion	BY 1301.6	End Term Quiz/ Class Test
36.	Lac operon	Learn Gene Regulation	Lecture	BY 1301.6	End Term
37.	Tutorial	Recall the process	Lecture	BY 1301.6	Quiz/ Class Test
38.	Lac operon: detail	Learn Gene Regulation	Lecture	BY 1301.6	End Term
39.	Tutorial	Recall the process	Discussion	BY 1301.6	Quiz/ Class Test
Lab sessions	Isolation and purification of DNA from microbial cell (Bacteria) and plant. Agarose gel electrophoresis of isolated DNA, Native and denature electrophoresis of protein using PAGE. Elution of DNA from agarose gel. Determination of plasmid in given bacterial strain. Perform Southern Blot Hybridization and Western Blot. Demonstration of DNA amplification by PCR.		Lab sessions	BY 1301.1 BY 1301.3	Experimental results in lab sessions End Term Practical Examination

I. Course Articulation Matrix: (Mapping of COs with POs)

		CORRELATION WITH PROGRAM							CORRELATION WITH		
СО	STATEMENT			οι	JTCON	1ES			PROG	RAM SP	ECIFIC
	STATEMENT								OUTCOMES		
			РО	PO	PO	PO	PO	PO	PSO	PSO	PSO
		1	2	3	4	5	6	7	1	2	3
[BY 1301.1]	Define the basic of central dogma	1							3		
	and understand various biological										
	processes through the										
	molecular mechanisms										
[BY 1301.2]	Understand the chemical and								2		
	molecular processes that occur in										
	and between cells.										
[BY 1301.3]	Apply various molecular									1	3
	techniques related to DNA as										
	genetic material thereby										
	biology										
FRY 1301 41	Examine the most significant									2	1
	molecular and cell-based methods									Z	T
	used today to expand the										
	employability in the field of										
	molecular biology										
[BY 1301.5]	Evaluate the mechanism behind	1							2		
	copying of DNA with extra										
	fidelity.										
[BY 1301.6]	Evaluate the process behind									3	
	tormation of KINA and proteins										
	and to investigate the molecular										
	mechanisms benind different										
	bacteria										
				1				1			

I- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

MANIPAL UNIVERSITY JAIPUR



School of Basic Sciences

Department of Chemistry Course Hand-out

Inorganic Chemistry IV | CY1413 | 4 Credits | 3104

Session: Jan. 18 – May 18 | Faculty: Dr. Veena Dhayal | Class: B.Sc. IV Semester (honors)

- A. Introduction: This course is offered by Dept. of Chemistry as a core course, targeting students who wish to pursue research& development in industries or higher studies in the field of Inorganic Chemistry. It offers in depth knowledge about d- and f-block elements, coordination compounds and various theories for bonding in coordination complexes. Students are expected to have background knowledge on d and f block elements and chemical bonding for a better learning.
- **B. Course Outcomes:** At the end of the course, students will be able to
 - [1413.1]. Describe the basic properties of d-block and f-block elements
 - [1413.2]. Discuss general characteristics of the coordination compounds
 - [1413.3]. Improve skills to predict type of bonding in coordination complexes

[1413.4]. Understand various aspects of the reactivity of coordination compounds

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

- [PO.1]. Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.
- [PO.2]. Effective Communication: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.
- [PO.3]. Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.
- [PO.4]. Effective Citizenship: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.
- [PO.5]. Ethics: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.
- [PO.6]. Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.
- [PO.7]. Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes

[PSO1]. Recognize and apply the fundamental concepts of chemistry and their applications.

[PSO2]. Employ critical thinking and scientific inquiry in the interpretation of theoretical knowledge at a level suitable to succeed at an entry-level position in chemical industry or a post graduate chemistry program.

[PSO3]. Understand the applications of chemical sciences in the areas of organic synthesis, synthesis of materials, corrosion inhibition, environment sustainability etc.

Criteria	Description	Maximum Marks
	Sessional Exam I	20
Internal Assessment	Sessional Exam II	20
(Summative)	In class Quizzes and Assignments , Activity feedbacks (Accumulated and Averaged)	10
End Term Exam	End Term Exam	50
(Summative)		
	Total	100
Attendance	A minimum of 75% Attendance is require	red to be maintained by a student to be
(Formative)	qualified for taking up the End Semest includes all types of leaves including medi	cer examination. The allowance of 25% cal leaves.
Make up Assignments	Students who miss a class will have to re	port to the teacher about the absence. A
(Formative)	has to be submitted within a week from t	he date of absence. No extensions will be
	given on this. The attendance for that p	particular day of absence will be marked
	blank, so that the student is not accour	nted for absence. These assignments are
Homework/ Home Assignment/ Activity Assignment	a flipped classroom. Although these work	y have to work in home, especially before a are not graded with marks. However, a
(Formative)	student is expected to participate and per	form these assignments with full zeal since
(i of mative)	the activity/ flipped classroom participatic will be awarded.	on by a student will be assessed and marks

E. SYLLABUS

Chemistry of 2nd and 3rd row d-block elements: Comparison of the chemistry of elements of second and third row series with that of elements of the first transition series. Mo-Mo and Re-Re quadrupole bonds. Chemistry of complexes of Rh(III), Pt(II) and Pd(II); **Chemistry of f-block elements**: Chemistry of Lanthanide elements, their isolation from one another, their coordination chemistry; **Coordination Compounds**: Various definitions, types of ligands, The Chelate and Macrocylic effects, Multidentate ligands, isomerism in coordination compounds, nomenclature, stability of coordination compounds, stability constants and chelate effect; **Theories for bonding in complexes**: Valence bond theory for bonding in coordination compounds. Concept of multiple bonding and back bonding; **Crystal field theory**: The splitting of d-orbitals in different fields, Consequences, factors affecting and applications of orbital splitting, crystal field stabilization energy (CFSE), magnetic properties, spectrochemical series and colour of transition metal complexes. Jahn-Teller effect in octahedral and tetrahedral complexes. Evidence of covalence and adjusted crystal field theory. Molecular orbital treatment of octahedral, tetrahedral and square planar complexes.

Text Books:

- 1. J. D. Lee, Concise Inorganic Chemistry, Blackwell Science, 2008.
- 2. J. E. Huheey, E. A. Keiterand R. L. Keiter, Inorganic Chemistry: Principles of Structure and Reactivity, Pearson India, 2008
- 3. D. Shriver and P. Atkins, Inorganic Chemistry, Oxford University Press, 2011.
- 4. N. N. Greenwood and A. Earnshaw, Chemistry of the Elements, Elsevier, 2010.

Reference Books:

1. F. A. Cotton, G. Wilkinson, C. A. Murillo and M. Bochmann, *Advanced Inorganic Chemistry*, Wiley India, 2007

F. Lecture Plan:

LEC NO	TOPICS
1	Chemistry of 2 nd and 3 rd row d-block elements: General properties
2 & 3	Comparison of the chemistry of elements of second and third row series with
	that of elements of the first transition series
4	Mo-Mo and Re-Re quadrupole bonds
5 & 6	Chemistry of complexes of Rh(III), Pt(II) and Pd(II);
7	Chemistry of f-block elements: general introduction
8	Chemistry of Lanthanide elements
9 & 10	Lanthanide isolation from one another and their coordination chemistry
11	Revision
12	Coordination Compounds: general introduction
13 & 14	Various definitions, types of ligands,
15 & 16	The Chelate and Macrocylic effects, Multidentate ligands,
17 & 18	isomerism in coordination compounds,
19 & 20	Nomenclature of coordination compounds
21 & 22	stability of coordination compounds, stability constants and chelate effect;
23	Theories for bonding in complexes: general introduction
24 & 25	Valence bond theory for bonding in coordination compounds.
26	Concept of multiple bonding and back bonding;
27	Revision
28 & 29	Crystal field theory: The splitting of d-orbitals in different fields
30 & 31	Consequences, factors affecting and applications of orbital splitting,
32	crystal field stabilization energy (CFSE),
33 & 34	magnetic properties, spectrochemical series and colour of transition metal complexes.
35 & 36	Jahn-Teller effect in octahedral and tetrahedral complexes.
37	Evidence of covalence and adjusted crystal field theory.
38-41	Molecular orbital treatment of octahedral, tetrahedral and square planar complexes.
42	Revision

Course Articulation Matrix: (Mapping of COs with POs) G.

со	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES					1ES	CORRELATION WITH PROGRAM SPECIFIC OUTCOMES			
		PO 1	РО 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3
CY1413.1	Describe the basic properties of d-block and f-block elements	1		1				2	2	1	2
CY1413.2	Discuss general characteristics of the coordination compounds		1			1			1		
CY1413.3	Understand various theories for bonding in coordination complexes			3			1			1	2
CY1413.4	Understand various aspects of the reactivity of coordination compounds	1				2		2	1		

I- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

H. Course Outcome Attainment Level Matrix:

со	STATEMENT		ATTAINMENT OF PROGRAM OUTCOMES THRESHOLD VALUE: 40%							ATTAINMENT OF PROGRAM SPECIFIC OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3	
CY1413.1	Describe the basic properties of d- block and f-block elements											
CY1413.2	Discuss general characteristics of the coordination compounds											
CY1413.3	Understand various theories for bonding in coordination complexes											
CY1413.4	Understand various aspects of the reactivity of coordination compounds											

0-No Attainment; I- Low Attainment; 2- Moderate Attainment; 3- Substantial Attainment

MANIPAL UNIVERSITY JAIPUR



School of Basic Sciences

Department of Chemistry Course Hand-out

Organic Chemistry III CY 1414 | 4 Credits | 3 | 0 4

Session: January 18 - May 18 | Faculty: Dr. Nitu Bhatnagar | Class: B.Sc (Hons.)

A. Introduction: This course is offered by Dept. of Chemistry. CY 1414 is the fourth course in the four semester organic chemistry lecture sequence that includes CY1113, CY1213, CY 1315 and CY 1414. It is a continuation of courses CY1113, CY1213, CY 1315 and emphasizes on the chemistry of Organo Sulphur and Organo Nitrogen compounds and heterocyclic compounds as well. It also introduces to the students the chemistry behind the importance of fats, oils and detergents and function of synthetic dyes. It provides a bridge between basic and more advanced organic chemistry knowledge.

B. Course Outcomes: At the end of the course, students will be able to

[1414.1]. Recognize the general methods of preparation of Organo-Nitrogen, Organo-Sulphur and heterocyclic compounds.

- [1414.2]. Discuss the general characteristics of Organo-Nitrogen, Organo-Sulphur and heterocyclic compounds.
- [1414.3]. Learn and understand the mechanisms of some reactions of Organo-Nitrogen, Organo-Sulphur and heterocyclic compounds.
- [1414.4]. Understand the chemistry behind use of fats, oils and detergents in different industries and synthesis of different types of synthetic dyes.
- [1414.5]. Enhance the scientific skills of students for employability.

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

- [PO.1]. Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.
- [PO.2]. Effective Communication: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.
- [PO.3]. Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.
- [PO.4]. Effective Citizenship: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.
- [PO.5]. Ethics: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.
- [PO.6]. Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.
- [PO.7]. Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes

Program Specific Outcomes for B.Sc (Hons) Chemistry Program

- [PSO.1]. Recognize and apply the fundamental concepts of chemistry and their applications.
- [PSO.2.]. Employ critical thinking and scientific inquiry in the interpretation of theoretical knowledge at a level suitable to succeed at an entry-level position in chemical industry or a post graduate chemistry program.
- [PSO.3.]. Understand the applications of chemical sciences in the areas of organic synthesis, synthesis of materials, corrosion inhibition, environment sustainability etc.

Criteria	Description	Maximum Marks
	Sessional Exam I (Open Book)	20
Internal Assessment	Sessional Exam II (Open Book)	20
(Summative)	In class Quizzes and Assignments,	10
	Activity feedbacks (Accumulated and	
	Averaged)	
End Term Exam	End Term Exam (Open Book)	50
(Summative)		
	Total	100
Attendance	A minimum of 75% attendance is requir	ed to be maintained by a student to be
(Formative)	qualified for taking up the End Semest	er examination. The allowance of 25%
	includes all types of leaves including med	ical leaves.
Make up Assignments	Students who misses a class will have to	report to the teacher about the absence.
(Formative)	A makeup assignment on the topic taught	on the day of absence will be given which
	has to be submitted within a week from t	he date of absence. No extensions will be
	given on this. The attendance for that p	articular day of absence will be marked
	blank, so that the student is not accoun	ted for absence. These assignments are
	limited to a maximum of 5 throughout th	e entire semester.
Homework/ Home Assignment/ Activity	There are situations where a student may	have to work in home, especially before
Assignment	a flipped classroom. Although these work	s are not graded with marks. However, a
(Formative)	student is expected to participate and p	perform these assignments with full zeal
	since the activity/ flipped classroom partie	cipation by a student will be assessed and
	marks will be awarded.	

E. SYLLABUS

Organic Compounds of Nitrogen: Preparation, Chemical reactions and Mechanisms of nucleophilic substitution of nitroalkanes and nitroarenes in difffrent media, Picric acid, Halonitroarenes, Stereochemistry of amines, Separation of a mixture of primary, secondary and tertiary amines, Gabricl-phthalimide reaction, Hoffmann bromamide reaction; Organosulphur Compounds: Nomenclature, structural features, methods of formation and chemical reactions of thiols, thioethers, sulphonic acids, sulphonamides and sulphaguanidine; Heterocyclic Compounds: Introduction (pyrrole, furan, thiophene and pyridine), Mechanism of electrophilic and nucleophilic substitution reactions, Comparison of basicity, five and six-membered heterocycles. Preparation and reactions of indole, quinoline and isoquinoline with special reference to Fischer indole synthesis, Skraup synthesis and Bischler-Napieralski synthesis. Mechanism of electrophilic substitution reactions of indole, quinoline and isoquinoline; Fats, Oils and Detergents: Natural fats, edible and industrial oils of vegetable origin, common fatty acids, glycerides, hydrogenation of unsaturated oils. Saponification value, iodine value, acid value. Soaps, synthetic detergents; Synthetic Dyes: Colour and constitution (electronic concept), Classification of dyes. Chemistry and synthesis of Methyl orange, Congo red, Malachite green, Crystal violet, Phenolphthalein, Fluorescein, Alizarin and Indigo.

Text Books:

- 1. R. T. Morrison, R. N. Boyd and S. K. Bhattacharjee, Organic Chemistry, Pearson India, 2011.
- 2. T. W. G. Solomons and C. B. Fryhle, Organic Chemistry, Wiley India, 2012.
- 3. P. Sykes, A Guidebook to Mechanism in Organic Chemistry, Pearson India, 2003.
- 4. I.L. Finer, Organic Chemistry, Volume I, Pearson India, 2002.
- 5. I.L. Finer, Organic Chemistry, Volume II, Pearson India, 2002.

Reference Books:

1. F. A. Carey and R. J. Sundberg, Advanced Organic Chemistry: Structure and Mechanisms (Part A), Springer India Private Limited, 2007.

2. F. A. Carey and R. J. Sundberg, Advanced Organic Chemistry: Reaction and Synthesis (Part B), Springer India Private Limited, 2007.

3. M. B. Smith, J. March, March's Advanced Organic Chemistry: Reactions, Mechanisms and Structure, Wiley, 2012.

F. Lecture Plan:

LEC NO	TOPICS						
1	Introduction and Course Hand-out briefing						
2,3	Preparation, Chemical reactions and Mechanisms of nucleophilic substitution of						
	nitroalkanes						
4,5	Preparation, Chemical reactions and Mechanisms of nucleophilic substitution of						
	nitroarenes in different media						
6	Picric acid, Halonitroarenes						
7	Stereochemistry of amines						
8,9	Separation of a mixture of primary, secondary and tertiary amines						
10	Gabriel-phthalimide reaction, Hoffmann bromamide reaction						
11	Revision						
12	Nomenclature, structural features, methods of formation and chemical reactions of thiols						
13	Nomenclature, structural features, methods of formation and chemical						
	reactions of thioethers						
14,15	Nomenclature, structural features, methods of formation and chemical						
	reactions of sulphonic acids, sulphonamides and sulphaguanidine						
16	Revision						
17	Introduction to Heterocyclic Compounds: pyrrole, furan, thiophene and pyridine						
18	Mechanism of electrophilic and nucleophilic substitution reactions						
19	Comparison of basicity, five and six-membered heterocycles						
20,21	Preparation and reactions of indole, quinoline and isoquinoline with special						
	reference to Fischer indole synthesis						
22	Skraup synthesis and Bischler-Napieralski synthesis						
23,24	Mechanism of electrophilic substitution reactions of indole, quinoline and						
	isoquinoline						
25	Revision						
26,27	Natural fats, edible and industrial oils of vegetable origin, common fatty acids,						
	glycerides, hydrogenation of unsaturated oils						
28	Saponification value, iodine value, acid value. Soaps, synthetic detergents						
29	Revision						
30,31	Colour and constitution (electronic concept) of synthetic dyes						
32	Classification of dyes						
33,34	Chemistry and synthesis of Methyl orange, Congo red						
36, 37	Chemistry and synthesis of Fluorescein, Alizarin						
38	Chemistry and synthesis of Indigo, Malachite green, ,						
39	Chemistry and synthesis of Crystal violet, Phenolphthalein						
40	Revision						
41	Conclusion and Course Summarization						

G. Course Articulation Matrix: (Mapping of COs with POs)

со	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES						CORRELATION WITH PROGRAM SPECIFIC OUTCOMES			
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3
	[1414.1]. Recognize the general methods of preparation of Organo-Nitrogen, Organo-Sulphur and heterocyclic compounds	3	2	5		5	2	3	3	3	1
	[1414.2]. Discuss the general characteristics of Organo-Nitrogen, Organo-Sulphur and heterocyclic compounds.	3					1	2	3	3	1
	[1414.3]. Learn and understand the mechanisms of some reactions of Organo-Nitrogen, Organo-Sulphur and heterocyclic compounds	3					2	1	3	3	1
	[1414.4]. Understand the chemistry behind use of fats, oils and detergents in different industries and synthesis of different types of synthetic dyes	3					3	2	3	3	1

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

MANIPAL UNIVERSITY JAIPUR



School of Basic Sciences

Department of Chemistry Course Hand-out

Physical Chemistry-IV | CY 1415 | 4 Credits | 3 | 0 4

Session: Jan 18 - May 18 | Coordinator: Susruta Samanta | Class: B.Sc. (IV Semester)

- **A.** Introduction: This course is offered by Dept. of Chemistry as a core subject in the 4th semester of the B.Sc. Chemistry Honours programme, with an emphasis on fundamental understanding of states of matter and surface phenomena. The course explains surface chemistry and adsorption. This covers principles of X-ray diffraction. Develops understanding of the colloidal state. The course also grows understanding of macromolecular systems such as polymers. Students are expected to have basic background knowledge of chemistry and mathematics for this course.
- **B.** Course Objectives: At the end of the course, students will be able to

[1415.1]. Recognize types of polymers and predict their applications.

[1415.2]. Explain the chemistry of processes occurring at the interface.

[1415.3]. Describe the chemistry of simple mixtures and solutions.

[1415.4]. Evaluate the effects of physical parameters on colloidal state and predict their applications.

[1415.5]. Evaluate the effects of physical parameters on the solid materials and apply the acquired skills to explain X-ray diffraction.

C. Program Outcomes and Program Specific Outcomes

- **[PO.1].** Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.
- **[PO.2].** Effective Communication: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.
- **[PO.3].** Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.
- **[PO.4].** Effective Citizenship: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.
- **[PO.5].** Ethics: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.
- **[PO.6].** Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.
- **[PO.7].** Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes

[PSO.1]. To understand the basic physics principles and apply these principles both in simple exercises and in more complex problems of advanced Physics.

[PSO.2]. To Understand and apply the fundamental concepts of Chemical Sciences, employ critical thinking and scientific queries at a suitable level to get success in Professional domain and / or Higher Studies.

[PSO.3]. To understand the Mathematical applications in science & Technology.

D. Assessment Plan:

Criteria	Description	Maximum Marks
	Sessional Exam I (Closed Book)	20
Internal Assessment	Sessional Exam II (Closed Book)	20
(Summative)	Quiz tests and assignments	10
	(Accumulated and Averaged)	
End Term Exam	End Term Exam (Closed Book)	50
(Summative)		
	Total	100
Attendance	A minimum of 75% Attendance is require	red to be maintained by a student
(Formative)	to be qualified for taking up the End Sem	nester examination. The allowance
	of 25% includes all types of leaves includi	ng medical leaves.
Homework/ Home Assignment/	There are situations where a studen	t may have to work in home,
Activity Assignment	especially before a flipped classroom. S	Some of these works are graded
(Formative)	with marks. A student is expected to	p participate and perform these
	assignments with full zeal since the activi	ty/ flipped classroom participation
	by a student will be assessed and marks w	will be awarded.

E. Syllabus

Surface Chemistry: Bulk phases and interfacial region, types of interfaces; Surface tension and interfacial tension, Surface tension of solutions, Gibbs adsorption equation and its thermodynamic derivation, Surfactants, Surface films on liquids;

X-ray diffraction: Definition of space lattice, unit cell. Miller indices, Symmetry elements in crystals. X-ray diffraction by crystals. Bragg equation. Dimension and contents of unit cell;

Adsorption: Adsorption of gases on solids, chemisorption and physi-sorption, desorption. Adsorption isotherms; **Colloids:** The colloidal state, preparation of colloidal dispersions, dialysis, ultrafiltration, physical & optical properties, ultra-microscope, Electro kinetic phenomena. Zeta potential. Precipitation of sols by electrolytes, Hardy Schulz rules, other methods of precipitation. Emulsions, Association colloids/colloidal surfactants/micelle systems;

Macromolecules: Introduction, nomenclature and classifications of macromolecules, Addition and condensation polymerization, Molecular weight heterogeneity, number average and weight average molecular weights, Determination of molecular weights.

F. Text Books

TI. P. Atkins and J. de Paula, Atkins's Physical Chemistry, Oxford University Press, NY, 2004.

T2. B.R. Puri, L.R. Sharma and M.S. Pathania, Principal of Physical Chemistry, Vishal Publication Jalandhar, 2010.

T3. A. Bahl, S. S. Bahl, G. D. Tuli, Essentials of Physical Chemistry, S. Chand, 2016.

T4. Chemistry – Atoms First, Openstax, 2015 (https://openstax.org/details/books/chemistry-atoms-first).

Reference Books

- I. G.M. Barrow, Physical Chemistry (special Indian Edition), Tata Mcgraw Hill Education Private Limited.
- 2. D.A. McQuarrie and J. D. Simon, Physical Chemistry: A molecular Approach, Viva books.
- 3. Ira N. Levine, Physical Chemistry, Tata McGraw Hill, 2007.

G. Lecture Plan:

Lec	Topics	Session Outcome	Mode of	Corresponding	Mode of Assessing
No			Delivery	СО	the Outcome
1.	Introduction to Physical Chemistry-IV	To acquaint and clear teacher's expectations and	Discussion	1415.1-5	None
2	Colloide: Introduction, types of colloids	Identify various types of colloids and explain their	Locturo		Mid Torm I
Ζ.	Colloids. Introduction, types of colloids	hereical properties	Discussion	1415.4	End Term
2	Kingtic optical and electrical properties	Demonstrate the physical and chemical	Locture	14154	
3.	Kinetic, optical and electrical properties	properties of colloids	Lecture	1415.4	Class Quiz End Torm
4.	Stability of colloids, protective action, Hardy-	Explain the rules of stability of a colloidal	Lecture,	1415.4	Assignment
	Schultz law, Gold number	dispersion	Activity		End Term
5.	Tutorial-I	Summarize the key ideas of the colloidal state	Activity	1415.4	All
6.	Surfactants and Micelles – HLB, micellization,	Conceptualize the process of micellization	Lecture,	1415.4	Mid Term I
	solubilisation		Activity		End Term
7.	Emulsions – classification, preparation,	Explain the widely used processes of the	Lecture	1415.4	Mid Term I
	properties	preparation and applications of emulsions	-		End term
8.	Sols and Gels – classifications, preparation	Explain the widely used processes of the	Lecture	1415.4	Mid Term I
		preparation and applications of sols and gels			End Term
9.	General application of colloids	Apply the knowledge of the colloidal state to	Lecture,	1415.4	Mid Term I
		formulate their applications in the industry and	Activity		End Term
	T	also in the everyday life	A		A 11
10.		Summarize the key ideas of the colloidal state	Activity	1415.4	All
11.	Surface Chemistry: Bulk phases and	Differentiate between the chemistry of bulk	Lecture,	1415.2-3	Mid Term II
	interfacial region, types of interfaces;	phase and the surface	Activity		End Term
12.	Surface tension and interfacial tension, Surface	Summarize the key surface properties	Lecture,	1415.2-3	
10	tension of solutions	Device the City of a set in its the sure	Activity		
13.	GIDDS adsorption equation and its	Derive the Gibbs adsorption isotherm	Lecture,	1415.2-3	All
	thermodynamic derivation	Cumananiza tha lucu idaaa af cumfaaa ah amiatmu	Activity		Class Quiz
14.	i utoriai-3	Summarize the key ideas of surface chemistry	Lecture,	1415.2-5	Class Quiz End Torm
45	Advantion: Advantion of more on colide	Summarize the process of advertises	Activity	1415.2	
15.	Ausorption: Ausorption of gases off solids,	Summarize the process of adsorption	Activity	1415.2	Class Quiz End Torm
16	Adsorption isotherms	Derive the different adsorption isotherms	Locture	1415.2	
16.		Derive the different adsorption isotherms	Lecture	1713.2	End Term
17.	The BET theory	Summarize the BET theory	Lecture	1415.2-3	Class Quiz
	,	,			End Term
18.	Tutorial-4	Summarize the key ideas of adsorption	Lecture	1415.2-3	Class Quiz
					End Term
19.	Adsorption from solution, Gibbs isotherm	Derive the Gibbs adsorption isotherm	Lecture,	1415.2-3	Class Quiz
			Activity		

20.	Surface films on liquids	Outline the properties of surface films	Lecture,	1415.2-3	All
			Activity		
21.	Modern techniques of investigating surfaces	Compare experimental techniques of surface	Lecture,	1415.2	Mid Term I
		investigation.	Discussion		End Term
22.	Tutorial-5	Summarize the key ideas of adsorption	Discussion	1415.2-3	End Term
23.	Macromolecules: introduction, nomenclature,	Describe polymers and their types	Lecture	1415.1	Mid Term II
	classification				End Term
24.	Functionality, Degree of polymerization, Co-	Differentiate the types of polymers	Discussion	1415.1	Assignment
	polymerization: alternating, random, block and		Assignment		
	graft polymers				
25.	Molecular weight of polymers: Number average	Calculate the molecular weight of polymer	Lecture	1415.1	Class Quiz
	and weight average molecular weights,	mixtures			End Term
	polydispersity index				
26.	Determination of molecular weight of polymers	Summarize the techniques to determine	Lecture	1415.1	All
		molecular weight of polymers			
27.	Tutorial-6	Summarize the key ideas of polymers	Lecture	1415.1	Assignment
					End Term
28.	Polymerization techniques: Bulk, Solution,	Compare the utilities of different polymerization	Lecture,	1415.1	Class Quiz
	Suspension, and Emulsion	techniques	Activity		End Term
29.	Free radical polymerization and ionic	Explain the mechanism of polymerization	Lecture	1415.1	Class Quiz
	polymerization	techniques			End Term
30.	Coordination and Condensation polymerization	Explain the mechanism of polymerization	Lecture	1415.1	Class Quiz
		techniques			End Term
31.	Tutorial-7	Summarize the key ideas of polymerization	Lecture	1415.1	All
32	Diffusion, Macromolecules in solution		Activity	1415.1	End Term
33	Kinetics of polymerization		Lecture,	1415.1	End Term
			Activity		
34	Thermodynamics of polymerization		Lecture,	1415.1	End Term
			Activity		
35	Conducting polymers		Lecture,	1415.1	Class Quiz
			Lab sessions		End Term
36	Tutorial-8	Summarize the key ideas of polymers	Lecture,	1415.1	All
			Activity		
37	Biopolymers: proteins - structure		Lecture,	1415.1	Class Quiz
			Activity		End Term
38	Helix-coil transformations		Lecture,	1415.1	Class Quiz
			Activity		End Term
39	Nucleic acids		Lecture,	1415.1	End Term
			Activity		
40	PCR, separation of proteins and nucleic acid		Lecture,	1415.1	All
			Activity		
41	Tutorial-9	Summarize the key ideas of biopolymers		1415.1	All
42	The solid state: introduction, symmetry, point	Explore the symmetry elements in a solid		1415.5	All

	groups	material		
43	Lattice, unit cell, lattice energy	Relate symmetry elements to a crystal lattice	4 5.5	
44	Born-Lande equation, Born-Haber cycle	Derive the energetics of crystal lattices	1415.5	
45	Tutorial-10	Summarize the key ideas of the solid state	4 5.5	
46	Law of rational indices, Miller indices	Derive the Miller indices for different types of	1415.5	
		cubic systems		
47	X-ray diffraction, Bragg equation	Interpret X-ray diffraction and justify its use to	1415.5	
		determine the structure of lattices		
48	Experimental methods	Summarize the techniques to determine physical	1415.5	
		properties of solid materials		
49	Tutorial-11	Summarize the key ideas of X-ray diffraction	1415.5	
50	Types of crystals	Compare the properties of different type of	1415.5	
		crystals		
51	Free electron model, Band theory, Conductors,	Implement the electronic theories to describe the	1415.5	
	Semiconductors, Insulators, Superconductivity	properties of different types of solid materials		
52	Imperfections, point defects	Explain the structural defects in a lattice	1415.5	
53	Tutorial-12	Summarize the key ideas of crystals	1415.5	
54	Tutorial-13	Summarize the key ideas of colloidal state	1415.4	
55	Tutorial-14	Summarize the key ideas of surface chemistry	1415.2	
56	Tutorial-15	Summarize the key ideas of macromolecules	1415.1	

H. Course Articulation Matrix: (Mapping of COs with POs)

со	STATEMENIT	CORRELATION WITH PROGRAM OUTCOMES						CORRELATION WITH PROGRAM SPECIFIC			
	STATEIVIENT								OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3
CY 1415.1	Recognize types of polymers and predict their applications	1					1	2	1	3	1
CY 1415.2	Explain the chemistry of processes occurring at the interface	1					1	2		2	
CY 1415.3	Describe the chemistry of simple mixtures and solutions	2					1	2	2	1	
CY 1415.4	Evaluate the effects of physical parameters on colloidal state and predict their applications	3					1	2	2	1	
CY 1415.5	Evaluate the effects of physical parameters on the solid materials and apply the knowledge to explain X-ray diffraction	2					1	2	2	3	1



School of Basic Sciences Department of Mathematics and Statistics Course Hand-out DYNAMICS | MA1412 | 4 Credits | 3 1 0 4 Session: Jan – May, 2018 | Faculty: Dr. Reema Jain| Class: B. Sc.(Pass Course) IV Sem

A. Introduction: This course introduces the concepts like position, velocity and acceleration, which describe the way an object moves. Also discusses the Newton's laws of motion, which predict the motion of an object when the forces acting on it are known. It also shows how Newton's second law of motion can be used to predict the motion of objects. The course concerns modelling some of the forces that occur in nature, which enables more realistic situations to be analyzed.

B. Course Outcomes: At the end of the course, students will be able to think logically.

[1412.1] Students will be able to understand the basic terms for the description of the motion of particles in a straight line and in a plane and it will hone their skills.

[1412.2] Learners will solve the problems relating to the Simple harmonic motion & motion of a projectile in the absence of air resistance.

[1412.3] Students will be able to understand the basic concepts of force, mass and acceleration, of work and energy and of impulse and momentum.

[1412.4] Students will demonstrate the ability to resolve the problems in one dimension that involve one or more of the forces of gravity, friction and air resistance

[1412.5] Students will be able to understand the orbital motion of planets in a lucid way and it will improve their employability.

Program Outcomes and Program Specific Outcomes

PO1.Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.

PO2.Effective Communication: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.

PO3. Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.

PO4. Effective Citizenship: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

PO5. Ethics: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.

PO6. Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.

PO7. Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes

[PSO.1] To understand the basic principles and apply these principles both in simple exercises and in more complex problems of advanced study.

[PSO2] To Understand and apply the fundamental concepts of Sciences, employ critical thinking and scientific queries at a suitable level to get success in Professional domain and / or Higher Studies.

[PSO.3] To understand the Mathematical applications in science & Technology.

Criteria		Description	Maximum Marks		
		Sessional Exam I (Closed	20		
Internal	Assessment	Book)			
(Summative)		Sessional Exam II (Closed	20		
		Book)			
		Quizzes , Assignments &	10		
		Presentation			
End Term Exam		End Term Exam (Closed	50		
(Summative)		Book)			

C. Assessment Plan:

Total 100	Total	100
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D. Syllabus

Kinematics: Radial, Transverse, tangential, normal velocities and accelerations. **SHM**: Repulsion from a fixed point, Motion under inverse square Law, Hooke's law, Horizontal and vertical elastic strings. **Projectiles**: Motion of a projectile and its trajectory, Time of flight, Horizontal range, Greatest height, Range and time of flight up and down an inclined plane. **Work Energy and Impulse**: Conservation of linear momentum, Principle of conservation of energy. **Uniform circular motion**: Motion on a smooth curve in a vertical plane, Motion on the inside of a smooth vertical circle, Cycloidal motion. **Motion in the resisting medium**: Resistance varies as velocity and square of velocity. Central orbits. Kepler's laws of planetary motion.

Text Books:

- A. S. Ramsey, Dynamics (Part I), The English Language Book Society and Cambridge University Press, 1962.
- 2. M. Ray, G. C. Sharma, A Text Book on Dynamics, S. Chand & Co., 2006.
- 3. M. D. Raisinghania, Dynamics, S. Chand & Co., 2015.

Reference Books:

- W. H. Besant, A. S. Ramsey, A Treatise on Hydromechanics Part I), G. Bell and Sons Ltd., London, 1960.
- 2. P. L. Meyer, Introduction to probability and statistical applications, IBH.
- 3. S. S. Sastry, Introductory methods of Numerical analysis, PHI.

E. Lecture Plan:

Торіс	Mode of delivery	Corresponding CO	No of hrs	Mode of Assessing the Outcome
Kinematics: Introduction	Lecture, Discussion & Examples	CO1	1	Quizzes, Two Sessional, End Term Examination
Radial velocity	Lecture, Discussion & Examples	CO1	1	Quizzes, Two Sessional, End Term Examination
Radial acceleration	Lecture, Discussion & Examples	CO1	1	Quizzes, Two Sessional, End Term Examination

Transverse velocity	Lecture, Discussion & Examples	CO1	1	Quizzes, Two Sessional, End
Transverse acceleration	Lecture, Discussion &	CO1	1	Term Examination Quizzes, Two Sessional End
	Examples			Term Examination
Tangential & Normal velocities	Lecture, Discussion & Examples	CO1	1	Quizzes, Two Sessional, End
		<u> </u>	1	Term Examination
l'angential & Normal	Lecture, Discussion &	COI	I	Quizzes, Iwo Sessional End
	Examples			Term Examination
Tutorial Class	Discussion & Examples	CO1	1	Quizzes, Two
				Sessional, End
		CO1	1	Term Examination
SHM (Simple Harmonic Motion) Untroduction	Lecture, Discussion &	COI	I	Quizzes, Iwo Sessional End
Within) : Introduction	Examples			Term Examination
Simple Harmonic Motion	Lecture, Discussion &	CO1	1	Ouizzes, Two
1	Examples			Sessional, End
	-			Term Examination
Motion under inverse square	Lecture, Discussion &	CO1	1	Quizzes, Two
Law	Examples			Sessional, End
		CO1	1	Term Examination
Hooke's law	Examples	COI	1	Quizzes, Iwo Sessional End
	Examples			Term Examination
Horizontal and vertical	Lecture, Discussion &	CO1	1	Ouizzes, Two
elastic strings	Examples			Sessional, End
_				Term Examination
Horizontal and vertical	Lecture, Discussion &	CO1	1	Quizzes, Two
elastic strings	Examples			Sessional, End
	Diamaria 9 Errora 1an	COL	1	Term Examination
l utorial Class	Discussion & Examples	COI	1	Quizzes, 1 wo
				Term Examination
Projectile : Introduction	Lecture, Discussion &	CO2	1	Quizzes, Two
3	Examples			Sessional, End
	_			Term Examination
Motion of a particle and its	Lecture, Discussion &	CO2	1	Quizzes, Two
trajectory	Examples			Sessional, End
Motion of a nartiala and ita	Lastura Disquesion &	<u> </u>	1	1 erm Examination
trajectory	Examples	002	1	Sessional Fnd
lujectory	Examples			Term Examination
Time of flight & Horizontal	Lecture, Discussion &	CO2	1	Quizzes, Two
range	Examples			Sessional, End
				Term Examination
Time of flight & Horizontal	Lecture, Discussion &	CO2	1	Quizzes, Two
range	Examples			Sessional, End
				I erm Examination

Greatest height and time of	Lecture, Discussion &	CO2	1	Quizzes, Two
flight up & down an inclined	Examples			Sessional, End
plane	I I			Term Examination
Greatest height and time of	Lecture, Discussion &	CO2	1	Quizzes, Two
flight up & down an inclined	Examples			Sessional, End
plane	I			Term Examination
Tutorial Class	Discussion & Examples	CO2	1	Quizzes, Two
	1			Sessional, End
				Term Examination
Work. Energy and	Lecture, Discussion &	CO3	1	Ouizzes, Two
Impulse: Introduction	Examples			Sessional. End
F = a = t	1			Term Examination
Conservation of linear	Lecture, Discussion &	CO3	1	Ouizzes, Two
momentum	Examples			Sessional, End
	1			Term Examination
Conservation of linear	Lecture, Discussion &	CO3	1	Ouizzes, Two
momentum	Examples			Sessional, End
	1			Term Examination
Principle of conservation of	Lecture, Discussion &	CO3	1	Ouizzes, Two
energy	Examples			Sessional, End
65	1			Term Examination
Principle of conservation of	Lecture, Discussion &	CO3	1	Ouizzes, Two
energy	Examples			Sessional, End
	1			Term Examination
Cycloidal motion	Lecture, Discussion &	CO3	1	Ouizzes, Two
	Examples			Sessional, End
	I			Term Examination
Cycloidal motion	Lecture, Discussion &	CO3	1	Quizzes, Two
	Examples			Sessional, End
	I			Term Examination
Tutorial Class	Discussion & Examples	CO3	1	Quizzes, Two
	1			Sessional, End
				Term Examination
Uniform circular motion:	Lecture, Discussion &	CO3	1	Quizzes, Two
Introduction	Examples			Sessional, End
	1			Term Examination
Motion on a smooth curve	Lecture, Discussion &	CO3	1	Quizzes, Two
in a vertical plane	Examples			Sessional, End
1	1			Term Examination
Motion on a smooth curve	Lecture, Discussion &	CO3	1	Quizzes, Two
in a vertical plane	Examples			Sessional, End
1	1			Term Examination
Motion on the inside of a	Lecture, Discussion &	CO3	1	Quizzes, Two
smooth vertical circle	Examples			Sessional, End
				Term Examination
Motion on the inside of a	Lecture, Discussion &	CO3	1	Quizzes, Two
smooth vertical circle	Examples			Sessional, End
				Term Examination
Tutorial Class	Discussion & Examples	CO3	1	Quizzes, Two
	`			Sessional, End
				Term Examination

Motion in the resisting medium: Introduction	Lecture, Discussion & Examples	CO4	1	Quizzes, Two Sessional, End
Resistance varies as velocity	Lecture, Discussion &	CO4	1	Quizzes, Two Sessional End
	Examples			Term Examination
Resistance varies as velocity	Lecture, Discussion &	CO4	1	Quizzes, Two
	Examples			Sessional, End
				Term Examination
Resistance varies as square	Lecture, Discussion &	CO4	1	Quizzes, Two
of velocity	Examples			Sessional, End
				Term Examination
Resistance varies as square	Lecture, Discussion &	CO4	1	Quizzes, Two
of velocity	Examples			Sessional, End
				Term Examination
Tutorial Class	Discussion & Examples	CO4	1	Quizzes, Two
				Sessional, End
				Term Examination
Central orbits	Lecture, Discussion &	CO5	1	Quizzes, Two
	Examples			Sessional, End
				Term Examination
Central orbits	Lecture, Discussion &	CO5	1	Quizzes, Two
	Examples			Sessional, End
				Term Examination
Kepler's laws of planetary	Lecture, Discussion &	CO5	1	Quizzes, Two
motion	Examples			Sessional, End
				Term Examination
Kepler's laws of planetary	Lecture, Discussion &	CO5	1	Quizzes, Two
motion	Examples			Sessional, End
	-			Term Examination
Tutorial Class	Discussion & Examples	CO5	1	Quizzes, Two
				Sessional, End
				Term Examination
			Total=	
			48 hrs	

СО	STATEMENT		CORRELATION WITH PROGRAM OUTCOMES CORRELATION WITH PROGRAM SPECIFIC OUTCOMES					ION RAM C ES								
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	P 0 7	PO 8	P C 9	PO 10	PO 11	PO 12	PS O 1	PS O 2	PS O 3
MA 1412.1	Students will be able to understand the basic terms for the description of the motion of particles in a straight line and in a plane.															
MA 1412.2	Learners will solve the problems relating to the motion of a projectile in the absence of air resistance. Learners will solve the problems relating to the Simple harmonic motion & motion of a projectile in the absence of air resistance.															
MA 1412.3	Students will be able to understand the basic concepts of force, mass and acceleration, of work and energy and of impulse and momentum.															
MA 1412.4	Students will demonstrate the ability to resolve the problems in one dimension that involve one or more of the forces of gravity, friction and air resistance.															
MA141 2. 5	Students will be able to understand the orbital motion of planets in a lucid way.															

F. Course Articulation Matrix: (Mapping of COs with POs)

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

MANIPAL UNIVERSITY JAIPUR



School of Computing and Information Technology

Department of Mathematics & Statistics Course Hand-out

Linear Programming Problems and Vector Calculus | MA 1417 | 4 Credits | 3 | 0 4

Session: January 18- May 18 | Faculty: Dr Laxmi Poonia | Class: Regular

- A. Introduction: This course is offered by Dept. of Mathematics & Statistics as a regular course, targeting students who wish to pursue B.Sc. (Hons) Chemistry, Physics, Psychology. It offers in depth knowledge of Linear programming problems and vector calculus. Students are expected to have background knowledge of basic mathematics like differentiation and integrations.
- B. Course Outcomes: At the end of the course, students will be able to

[1416.1]. Demonstrate an understanding the applications of linear programming. Constructs and apply the solution methods for linear programming models. Using the graphical method, and interpret the solution for two or more linear inequalities in two unknowns and develop skills of constructing the constraints and the objective function for a linear programming problem from everyday life.

[1416.2]. Use the simplex method to solve maximum and minimum linear programming problems from everyday life. Understand the meaning of duality and their role in the design of algorithmic solutions to linear programming problems .

[1416.3]. Explain the transportation model and the solution methods, algorithms of transportation models. Recognizes and develops the assignment model solution methods which can be helpful to increase employability of students.

[1416.4]. Study the Flux and motion of fluid in the vector field.

[1416.5]. Solve the problems of Integration of vectors by application of vector theorems.

PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

- [PO.1]. Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.
- [PO.2]. Effective Communication: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.
- [PO.3]. Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.
- [PO.4]. Effective Citizenship: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.
- [PO.5]. Ethics: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.
- [PO.6]. Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.
- [PO.7]. Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes
- [PSO.1] To understand the basic principles and apply these principles both in simple exercises and in more complex problems of advanced study.
- [PSO2] To Understand and apply the fundamental concepts of Sciences, employ critical thinking and scientific queries at a suitable level to get success in Professional domain and / or Higher Studies.
- [PSO.3] To understand the Mathematical applications in science & Technology.

A. Assessment Plan:

Criteria	Description	Maximum Marks			
	Sessional Exam I (Closed Book)	20			
Internal Assessment	Sessional Exam II (Closed Book)	20			
(Summative)	In class Quizzes and Assignments ,	10			
	Activity feedbacks (Accumulated and				
	Averaged)				
End Term Exam	End Term Exam (Closed Book)	50			
(Summative)					
	Total	100			
Attendance	A minimum of 75% Attendance is required to be maintained by a student to h				
(Formative)	qualified for taking up the End Semester examination. The allowance of 25%				
	includes all types of leaves including medi	cal leaves.			
Make up Assignments	Students who misses a class will have to	report to the teacher about the absence.			
(Formative)	A makeup assignment on the topic taught	on the day of absence will be given which			
	has to be submitted within a week from t	he date of absence. No extensions will be			
	given on this. The attendance for that p	particular day of absence will be marked			
	blank, so that the student is not accour	ited for absence. These assignments are			
	limited to a maximum of 5 throughout th	e entire semester.			
Homework/ Home Assignment/	There are situations where a student may	have to work in home, especially before			
Activity Assignment	a flipped classroom. Although these work	s are not graded with marks. However, a			
(Formative)	student is expected to participate and perform these assignments with full zeal since				
	the activity/ flipped classroom participatic will be awarded.	on by a student will be assessed and marks			

B. SYLLABUS

Introduction: Mathematical formulation, Graphical method of solution, Theory and application of the simplex method, Charne's M-technique, two phase method. **Duality:** Primal, Dual, Dual programming problem, Fundamental theorem of duality with proof. **Transportation Problems:** North-west corner rule, Matrix-minima method, Vogel's approximation method, MODI method for optimal solution. **Assignment Problems:** Hungarian method, Travelling salesman problem.

Vector Calculus: Differentiation. Gradient, Divergence and curl, line integral, surface integral, and volume integral. Green, Gauss and Stokes Theorems (without proof) and their applications.

Text Books:

- 1. G. Hadley, Linear Programming, Narosa Publishing House, 1995.
- 2. R. K. Gupta, Linear Programming, Krishna Prakashan, 2010.
- 3. Shanti Narayan, P. K. Mittal, A Textbook of Vector Analysis, S. Chand & Co., 2013.

Reference Books:

- 1. S. I. Gass, Linear Programming: Methods and Applications, McGraw Hill, New York, 1985.
- 2. S. D. Sharma, Operation Research, Kedarnath and Ram Nath Publication, 2006.
- 3. Hamdy A. Taha, Operations Research: An Introduction, PHI, 2006.
- 4. J. E. Marsden, A. Tromba, Vector Calculus, W. H. Freeman, 2003.

C. Lecture Plan:

Lecture No.	Chapter Name	Topics
1	Introduction to LPP	Introduction; formulation of an LPP
2		General form of linear programming problem
3		Graphical method of solution of LPP
4		Nature of the solution of an LPP
5		Areas of application of linear programming
6		Solving Related problems
7	Simplex Method	Simplex method: Reduction of a feasible solution to a basic feasible solution
8	•	Some definitions and notations;
9		Improving a basic feasible solution; Optimality condition;.
10		Solving Related problems, Unboundedness
11		Simplex algorithm
12		Procedural techniques
13		Initial basic feasible solution
14		Simplex table
15		Solving Related problems
16		Simplex method for maximization of an LPP standard form
17		Minimization problem in standard form
18		Big M method
19		Two phase method
20		Solving Related problems
21	Duality in LPP	Duality: Concept of duality
22		Mathematical formulation of duals-construction of duals
23		Duality theorems
24		Solving Related problems
25		Complementary slackness
26		Duality and simplex method.
27		Solving Related problems
28	Transportation Problems	Transportation: Introduction to transportation problem
29		Initial basic feasible solution
30		Moving towards optimality;
31		Degeneracy in transportation problems
32		Solving Related problems
33		Unbalanced transportation problem
34		Solving Related problems
35	Assignment Problems	Assignments: Mathematical formulation of assignment problems
36		Hungarian method for solving assignment problem
37		Unbalanced assignment problem
38		Travelling salesman problem
		Formulation of travelling salesman problem as an assignment problem and
39		solution procedure
40	Vector Calculus	Introduction:
41		Differentiation
42		Gradient
43		Divergence
44		curl
45		line integral
46		surface integral
47		volume integral
48		Green Theorem
50		Gauss Theorem
51		Stokes Theorem
52		Related problems

D. Course Articulation Matrix: (Mapping of COs with POs and PSOs)

			COR	RELAT	ION V	NITH F	ROGR	١M	CORRELATION		
со	STATEMENIT			C	DUTC	OMES			WITH PROGRAM		
	STATEMENT								SPECIFIC		
									OUTCOMES		
		PO	Р	PO	Р	PO	PO	PO 7	PSO	PSO	PSO
		1	0	3	0	5	6		1	2	3
			2		4						
MA1417.1]. Demonstrate an understanding the applications of linear programming. Constructs and apply the solution methods for linear programming models. Using the graphical method, and interpret the solution for two or more linear inequalities in two unknowns and develop skills of constructing the constraints and the objective function for a linear programming problem from everyday life .	3		1				2	3	2	3
MA1417.2	Use the simplex method to solve maximum and minimum linear programming problems from everyday life. Understand the meaning of duality and their role in the design of algorithmic solutions to linear programming problems.	3		2			1	2	3	3	3
MA1417.3	Explain the transportation model and the solution methods, algorithms of transportation models. Recognizes and develops the assignment model solution methods which can be helpful to increase employability of students.	3		1				2	3	3	3
MA1417.4] Explain the transportation model and the solution methods, algorithms of transportation models. Recognizes and develops the assignment model solution methods	3					1	2	2	2	2
MA1417.5	Solve the problems of Integration of vectors by application of vector theorems	3						2	2	2	3

I.Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

E.Course Outcome Attainment Level Matrix:

со	STATEMENT	ATT	AINMEI Thr	IMENT OF PROGRAM OUTCOMES THRESHOLD VALUE: 40%POPOPOPOPO234567111122212					ATTAINMENT OF PROGRAM SPECIFIC OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3
MA1416.1	Demonstrate an understanding the applications of linear programming. Constructs and apply the solution methods for linear programming models. Using the graphical method, and interpret the solution for two or more linear inequalities in two unknowns and develop skills of constructing the constraints and the objective function for a linear programming problem from everyday life .	3		1	T			2	3	2	3
MA1416.2	Use the simplex method to solve maximum and minimum linear programming problems from everyday life. Understand the meaning of duality and their role in the design of algorithmic solutions to linear programming problems.	3		2			1	2	3	3	3
MA1416.3	3 Explain the transportation model and the solution methods, algorithms of transportation models. Recognizes and develops the assignment model solution methods which can be helpful to increase employability of students			1				2	3	3	3
MA1416.4] Explain the transportation model and the solution methods, algorithms of transportation models. Recognizes and develops the assignment model solution methods	3					1	2	2	2	2
MA1416.5	Solve the problems of Integration of vectors by application of vector theorems	3						2	2	2	3

0-No Attainment; 1- Low Attainment; 2- Moderate Attainment; 3- Substantial Attainment

MANIPAL UNIVERSITY JAIPUR



School of Basic Sciences

Department of Biosciences Course Hand-out

Morphology and Anatomy of Angiosperms | BY 1401 | 3 Credits | 2 | 0 3

Session: 2018-2019 | Faculty: Dr. Jain Rohit | Class: IV Semester

- A. Introduction: This course is offered by Dept. of Biosciences as a core course in B.Sc. (pass) Biotechnology, Botany/Bioscience & Chemistry/Psychology and, as a subsidiary course in B.Sc. (Hons) Biotechnology Programme targeting students who wish to pursue their career in the research of Spermatophyta or Angiosperms. The course offers in depth knowledge of distribution, morphology and anatomy of different angiosperms. Students will be able to identify the different forms of plants which are growing in the nearby area. Also, the students will learn about the importance of different tissues of plants and their applications in preparation of food, beverages, fibres, wood, resins etc. Students are expected to have background knowledge of the different types of staining techniques and identification of modifications of plant tissues.
- **B. Course Outcomes:** At the end of the course, students will be able to
 - [BY 1401.1]. Classify the Angiospermic plants of surroundings in Annual, Biennial and Perennial forms
 - **[BY 1401.2].** Identify the modification of different parts of angiosperms, which are used in preparation of daily food, oil, fibre, beveragers etc.
 - **[BY 1401.3].** Compare different Angiospermic flowers and their modifications in the environment.
 - **[BY 1401.4].** Differentiate between the different vascular tissues such as xylem and phloem and discuss their importance to humans as fibres, wood, latex etc.
 - **[BY 1401.5].** Investigate the process of floral development from vegetative shoot and difference between monocotyledonous and dicotyledonous plants
 - **[BY 1401.6].** Classify different types of woods and develop methods for identification of its chemical composition for better quality hence increase the skills for employability in timber industries

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

- **[PO.I].** Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational and personal) from different perspectives.
- **[PO.2]. Effective Communication:** Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.
- **[PO.3].** Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.
- **[PO.4].** Effective Citizenship: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.
- **[PO.5].** Ethics: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.
- **[PO.6]. Environment and Sustainability:** Understand the issues of environmental contexts and sustainable development.
- **[PO.7].** Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes.

- **[PSO.1.]** To demonstrate competency in factual content and interpretation of the major biological concept areas of cell and molecular biology, genetics, organismal biology, and evolution and ecology.
- **[PSO.2.]** To demonstrate the ability to identify significant biological research questions, develop research protocols, and properly analyze research questions through the use of the scientific method.
- **[PSO.3.]** Enhance analytical and quantitative skills and demonstrate an understanding of basic computational and statistical techniques in the field of Biotechnology

D. Assessment Plan:

Criteria	Description	Maximum Marks
	Mid Term Exam I – IA I	20
Internal Assessment	Mid Term Exam 2 - IA 2	20
(IA)	CWS Assessment IA 3	10
	10 marks of IA 3 are awarded based on the various	
	assignments, class tests, seminar presentation etc.	
End Term Exam (EX)	End Term Exam – EX I	50
	Total	100

NOTE: A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.

E. SYLLABUS

Morphology: Diversity of plant forms in annuals, biennials and perennials. Evolution of tree habit in monocotyledons and dicotyledons. Characteristics of monocotyledons and dicotyledons. Study of root, stem and leaf (structure and function). Primary and secondary growth, anomalous secondary growth in monocots and dicots. Anatomy: Tissue: simple and complex permanent tissues; types of meristem. Theories of origin of basic body parts of plants: histogen theory, tunica-corpus theory. Cambium, periderm, secretory, laticifer ducts and lenticels. Origin and development of leaf, stem, root system: root hair, branching and its patterns. Comparative anatomy of root, stem and leaf.

F. TEXT BOOKS

- 1. Singh, V., Pandey, P.C. and Jain, D.K. A Text Book of Angiosperms, Rastogi Publications, Merrut, 2008.
- 2. Pandey, B.P., Plant Anatomy, S. Chand & Co., New Delhi, 2012,
- 3. Eames, J. An Introduction to Plant Anatomy, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1997.

G. REFERENCE BOOKS

- I. Grewal, R.C. Plant Anatomy. Campus Books International, New Delhi, 2009.
- 2. Coulter J. M., Chamberlain C. J. Morphology of angiosperms.. N. Y.: D. Appleton and Company (Digital) New York, 1909.

H. Lecture Plan:

Lecture	Торіс	Session Outcome	Mode of Delivery	Corresponding CO	Mode of assessing the outcome
Ι.	Introduction to Angiosperms, Scientific names of important crops, fruits, vegetables and medicinal plant	Identify the plants with their scientific names and explain their importance	Lecture	BY 1401.1	MTE I Quiz ETE
2.	Diversity of plant forms in annuals, biennials and perennials and their examples	Classify plants into annuals, biennials and perennials	Lecture	BY 1401.1	MTE I Test ETE
3.	Tutorial	Recall the importance of different plants and classify them	Discussion	BY 1401.1	Quiz/Assignment
4.	Evolution of tree habit in monocotyledons and dicotyledons	Explain the characteristics of monocots and dicots	Lecture	BY 1401.5	MTE I Test ETE
5.	Morphology of root, types of roots and examples	Classify the plants based on their root type	Lecture	BY 1401.4	MTE I Test ETE
6.	Tutorial	Differentiate between tree habit of monocot and dicot	Discussion	BY 1401.5	Test/Quiz
7.	Root: Modifications for different functions	Identify the root modifications in the surrounding environments	Lecture	BY 1401.2	MTE I Test ETE
8.	Roots developed for specific environments, Primary and Secondary functions of roots	Discuss the functions of roots developed for specific environments	Lecture	BY 1401.3	MTE I Test ETE
9.	Tutorial	Recall the root modifications and their importance in different environments	Discussion	BY 1401.2	Test/Quiz
10.	Stem morphology, types of stems and branching, functions of stem	Discuss different functions of stem and understand its morphology	Lecture	BY 1401.4	MTE I Test ETE
11.	Modifications of stems	Identify different stem modifications in surrounding area	Lecture	BY 1401.2	MTE I Quiz ETE
12.	Tutorial	Enlist examples of different stem modifications	Discussion	BY 1401.2	Test/Quiz
13.	Morphology of Leaf: Phyllotaxy, Venetion and types of stipule	Identify the venation, phyllotaxy and type of stipule in surrounding plants	Lecture	BY 1401.3	MTE 2 Test ETE
14.	Modifications of leaf for specific functions	Discuss the role of different leaf modifications	Lecture	BY 1401.2	MTE 2 Test ETE
15.	Tutorial	Recall the role of leaf modifications and	Discussion	BY 1401.3	Test/Assignment

		identify the leaf morphology in			
16.	Morphology of Flower, types of aestivation, parts of flower	Identify the floral morphology of flowers growing in natural habitat	Lecture	BY 1401.3	MTE 2 Assignment ETE
17.	Plant tissues: definition, types of tissues, classification	Understand the types and functions of plant tissues	Lecture	BY 1401.4	MTE 2 Quiz ETE
18.	Tutorial	Recall the floral morphology pattern and types of plant tissues	Discussion	BY 1401.4 BY 1401.3	Test/Quiz
19.	Apical meristem: theories of shoot apical meristem	Explain the theory of apical shoot meristem	Lecture	BY 1401.5	MTE 2 Quiz ETE
20.	Theories of Root apical meristem	Discuss different theories of apical root meristem	Lecture	-	MTE 2 Quiz ETE
21.	Tutorial	Compare different theories of shoot and root apical meristem	Discussion	BY 1401.5	Test/Quiz
22.	Simple tissue characteristic features, modifications and function	Discuss the characteristics and functions of different tissue modification systems	Lecture	BY 1401.4	MTE 2 Test ETE
23.	Parenchyma, Collenchyma & Sclerenchyma	Differentiate between Parenchyma, Collenchyma and Sclerenchyma	Lecture	BY 1401.4	MTE 2 Test ETE
24.	Tutorial	Recall the functions of different plant tissues	Discussion	BY 1401.4	Test/Quiz
25.	Fibres: Xylary fibres, extraxyllary fibres, slcerides	Understand different types of fibres and their importance	Lecture	BY 1401.2	Assignment ETE
26.	Complex tissues: Xylem and phloem, characteristic features, different parts and major functions	Compare the functions and characteristics of xylem and phloem	Lecture	BY 1401.4	Test ETE
27.	Tutorial	Recall the types of fibres and functions of xylem and phloem	Discussion	BY 1401.2 BY 1401.4	Test/Quiz
28.	Cambium, periderm, secretory glands, laticifer ducts and lenticels	Explain the basic cellular structure of wood/stem	Lecture	BY 1401.4	Test ETE
29.	Secondary growth in dicots: activity of vascular and cork cambium	Understand the role of vascular and cork cambium in secondary growth	Lecture	BY 1401.6	Assignment ETE
30.	Tutorial	Recall the cellular structure of stem/wood and secondary growth	Discussion	BY 1401.6	Test/Quiz
31.	Anomalous secondary growth in monocots and dicots	Compare the anomalous secondary growth in monocots and dicots	Lecture	BY 1401.6	Assignment ETE
32.	Specific structures: Root hairs, stomata, bulliform cells	Understand the anatomy of root hair, stomata and bulliform cells	Lecture	BY 1401.5	Test ETE

33.	Tutorial	Recall the anomalous secondary growth	Discussion	-	Test/Quiz
		structures			
34.	Primary tissues of root, stem and leaves	Understand the primary tissues of plant	Lecture	-	Quiz
		parts			ETE
35.	Comparative anatomy: Dicot and monocot	Compare the anatomical structures of	Lecture	BY 1401.5	Assignment
	root, stem and leaf	dicot and monocot plant parts			ETE
36.	Tutorial	Classify the plants as dicot and monocot	Discussion	BY 1401.5	Test/Quiz
		based on their morphology			
Lab	To prepare slides of leaf, stem and root and	Classify the plant into monocot or dicot	Lab Sessions	BY 1401.3	Experimental results in 24
Sessions	classify the plants into monocot or dicot	based on their anatomical and		BY 1401.4	lab sessions
	To identify plants based on their	morphological characteristics		BY 1401.5	End Term Practical
	morphological and anatomical characteristics				Examination
	in the surrounding area				

			CORRELATION WITH PROGRAM				CORRELATION WITH				
со	STATEMENT		OUTCOMES PROGRAM S						gram Sf	PECIFIC	
								OUTCOMES			
		PO	PO PO PO PO PO PO 7					PSO I	PSO 2	PSO 3	
		I	2	3	4	5	6				
[BY 1401.1].	Classify the Angiospermic plants of surroundings in								3		1
	Annual, Biennial and Perennial forms										
[BY 1401.2].	Identify the modification of different parts of									1	2
	angiosperms, which are used in preparation of daily										
	food, oil, fibre, beveragers etc.										
[BY 1401.3].	Compare different Angiospermic flowers and their										
	modifications in the environment										
[BY 1401.4].	Differentiate between the different vascular tissues									1	
	such as xylem and phloem and discuss their										
	importance to humans as fibres, wood, latex etc.										
[BY 1401.5].	Investigate the process of floral development from	Ι								2	
	vegetative shoot and difference between										
	monocotyledonous and dicotyledonous plants										
[BY 1401.6].	Classify different types of woods and develop							1			
	methods for identification of its chemical composition										
	for better quality hence increase the skills for										
	employability in timber industries										
		I	· · · · ·		C				Complex		· · · · · · · · · · · · · · · · · · ·

I- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation


School of Basic Sciences

Department of Biosciences Course Hand-out

Analytical Techniques BY 1402 | 3 Credits | 2 | 0 3

Session: 2018 - 2019 Faculty: Dr. Mousumi Debnath | Class: IV Semester

- A. Introduction: This course is offered by Dept. of Biosciences as a core course in B.Sc. (pass) Biotechnology and, as a subsidiary course in B.Sc. (Hons) Biotechnology Programme targeting students who wish to pursue their career in the research field of instrumentation techniques or higher studies in the field of experimentation related to use and applications of various instruments. The course offers in depth knowledge of instruments like pH meter, electrophoresis unit, chromatography, centrifugation etc. Students are expected to have background knowledge of the different types of instruments.
- **B. Course Outcomes:** At the end of the course, students will be able to:
 - **[BY1402.1]** State the principle of various analytical instruments used in life sciences for analysis of different biological samples
 - [BY1402.2] Explain the working of different types of biological instruments
 - [BY1402.3] Apply different biological techniques for analysing different types of biological samples
 - [BY1402.4] Distinguish between different types of spectrophotometric and electrophoretic techniques
 - **[BY1402.5]** Select appropriate technique for analysing different types of samples such as biomolecules, plant and animal tissues, *etc*
 - **[BY1402.6]** Investigate the nature and activity of different biomolecules using spectrophotometric, electrophoretic and microscopic techniques
 - [BY1402.7] Use the different tools and knowledge of analytical technique to increase employability skills

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

- **[PO.I].** Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational and personal) from different perspectives.
- **[PO.2]. Effective Communication:** Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.
- **[PO.3].** Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.
- **[PO.4]. Effective Citizenship:** Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.
- **[PO.5].** Ethics: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.
- **[PO.6].** Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.
- **[PO.7].** Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes.

- **[PSO.I.]** To demonstrate competency in factual content and interpretation of the major biological concept areas of cell and molecular biology, genetics, organismal biology, and evolution and ecology.
- **[PSO.2.]** To demonstrate the ability to identify significant biological research questions, develop research protocols, and properly analyze research questions through the use of the scientific method.
- **[PSO.3.]** Enhance analytical and quantitative skills and demonstrate an understanding of basic computational and statistical techniques in the field of Biotechnology

D. Assessment Plan:

Criteria	Description	Maximum Marks
	Mid Term Exam I – IA I	20
Internal Assessment	Mid Term Exam 2 - IA 2	20
(IA)	CWS Assessment IA 3	10
	10 marks of IA 3 are awarded based on the various	
	assignments, class tests, seminar presentation etc.	
End Term Exam (EX)	End Term Exam – EX I	50
	Total	100

Note: A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.

E. SYLLABUS

Microscopy: light microscope- resolution and visibility, types, applications of microscopes. **pH meter:** calibration and standardization of pH meter, calibration of colorimeter, calibration curve, principle, description and application of colorimeter. **Electrophoresis**: principle, types, horizontal, vertical and two dimensional gel electrophoresis. **Spectroscopy:** principle and law of absorption- Beer -Lambert's law, UV-visible spectroscopy. **Chromatography**: principle, types - paper, thin layer, adsorption, ion-exchange, affinity, gel filtration, gas and HPLC, ion exchange chromatography. **Centrifugation**: principle of sedimentation, types and uses, different types of rotors and autoradiography.

I. Ghatak, K. Techniques and Methods in Biology, PHI Learning Pvt. Ltd., New Delhi, 2011.

2. Rana, S.V.S. Biotechniques: Theory and Practice, Rastogi Publications, Meerut, 2007

G. REFERENCE BOOKS

1 Willard H.and Merrit, H. Instrumental Methods of Analysis, Prentice Hall India Publications, New Delhi, 2008.

2. Skoog, D. Instrumental Methods of Analysis, International Thomson Computer Press, UK, 2007.

H. Lecture Plan:

LEC	TOPICS	Session Outcome	Mode of	Corresponding	Mode of
NO			Delivery	со	assessing
					the
	Introduction and Course	To acquaint and clear	Lecture	NA	NA
	Hand-out briefing	teachers expectations	Lecture		
		and understand student			
		expectations			
2.	Microscopy: light microscope:	Learn the principle of	Lecture	BY 1402.2	MTE I
	Principle	compound microscope			Quiz
					End Term
3.	Resolution and visibility of light	Understand details of	Lecture	BY 1402.2	MTE I
	microscope	compound microscope			Quiz
	T			DV 1402.2	End Ierm
4.	lutorial	functioning	Discussion	BT 1402.2	Class Test/
5	Types of microscopes	Learn different types of	Locturo	BY 1402.2	
5.	Types of finct oscopes	microscope	Lecture		
					End Term
6.	Applications of microscopes	Understand various uses	Lecture	BY 1402.2	MTEI
		of microscope			Quiz
					End Term
7.	Tutorial	Recall details of various	Discussion	BY 1402.2	Class Test/
		microscopes			Quiz
8.	pH meter: Principle and	Discuss principle behind	Lecture	BY 1402.3	MTE I
	calibration of pH meter	working of pH meter			Quiz
					End Term
9.	Standardization and applications	Learn working of pH	Lecture	BY 1402.3	MIEI
	of pri meter	meter			Quiz End Torm
10	Tutorial	Recall oH meter	Discussion	BY 1402 3	Class test/
			Discussion	01 1102.0	Quiz
11.	Calibration of colorimeter,	Learn working of	Lecture	BY 1402.4	MTE I
	calibration curve, principle,	colorimeter			Quiz
	description and applications				End Term
12.	Spectroscopy: principle and law	Learn working of	Lecture	BY 1402.4	MTE I
	of absorption- Beer -Lambert's	spectroscopy			Quiz
	law				End Term
13.	UV-visible spectroscopy and its	Learn working of	Lecture	ВТ 1402.4	
	αμριιζατίστις	эреси озсору			Quiz End Torm
14	Tutorial	Becall spectroscopy	Discussion	BY 1402 4	
		Recail specil oscopy		ד.ערו וט.	Ouiz
15.	History of Electrophoresis	Learn about conventional	Lecture	BY 1402.1	MTE 2
	···· , · · · · · · · · · · · · · · · ·	electrophoresis and			Quiz
		discovery			End Term
16.	Electrophoresis: principle of	Understand ways to	Lecture	BY 1402.1	MTE 2
	horizontal gel electrophoresis	separate DNA and its			Quiz
		principle			End Term
17.	Tutorial	Recall the techniques	Discussion	BY 1402.1	Class Test/
		of nucleic acid			Quiz
10	Duffere and their value in a set	separation	1 • • • · · · ·		
١٥.	sel electrophoresis	reagents to separate	Lecture	DI 1402.1	
	0	nucleic acid			End Term
1		1	1	1	

19.	Methodology and applications	Learn about method of	Lecture	BY 1402.1	MTE 2
	of agarose gel electrophoresis	DNA/RNA separation			Quiz
					End Term
20.	Electrophoresis: principle of	Learn about protein	Lecture	BY 1402.1/	MTE 2
	vertical gel electrophoresis	separation principle		BY 1402.6	Quiz
					End Term
21.	Tutorial	Recall the techniques	Discussion	BY 1402.1/	Class Test/
		of protein separation		BY 1402.6	Quiz
22.	Buffers and their role in	Understand role of	Lecture	BY 1402.1/	MTE 2
	Vertical gel electrophoresis	reagents to separate		BY 1402.6	Quiz
		proteins			End Term
23.	Methodology and applications	Learn applications and	Lecture	BY 1402.1/	MTE 2
	of vertical gel electrophoresis	method of protein		BY 1402.6	Quiz
		separation			End Term
24.	Two dimensional gel	Understand 2-D gels	Lecture	BY 1402.1/	MTE 2
	electrophoresis			BY 1402.6	Quiz
					End Term
25.	Tutorial	Recall the techniques	Discussion	BY 1402.1/	Class Test/
		of protein separation		BY 1402.6	Quiz
26.	Chromatography and its	Understand concept of	Lecture	BY 1402.1/	MTE 2
	principle	Chromatography		BY 1402.6	Quiz
					End Term
27.	Paper and Adsorption	Discuss types of	Lecture	BY 1402.1/	MTE 2
	chromatography	chromatography and		BY 1402.6	Quiz
		paper chromatography			End Term
28.	Thin layer chromatography	Understand how thin	Lecture	BY 1402.1/	MTE 2
		layer chromatography is		BY 1402.6	Quiz
		different from paper			End Term
		chromatography and			
20	lan ayahanga	discuss types in details			
27.	ion-exchange	Discuss Ion-exchange	Lecture	DI 1402.1/	
	chronatography	chromatography		DI 1 1 02.0	Quiz End Torm
30	Affinity chromatography	Discuss Affinity	Locturo	BY 1402 1/	
50.		chromatography	Lecture	BY 1402.17	
		chi omatogi apriy		DT 1 1 02.0	End Term
31	Gol filtration	Lindorstand Gol	Locturo	BY 1402 1/	
51.	Germanon	filtration	Lecture	BY 1402.17	
				DT 1402.0	End Term
32	НРС	Learn high performance	Lecture	BY 1402 1/	MTF 2
52.		liquid chromatography	Lecture	BY 1402.17	
		1		21 102.0	End Term
33	Gas chromatography	Discuss gas	Lecture	BY 1402 1/	MTF 2
		chromatography		BY 1402.6	Quiz
				BT 1102.0	End Term
34	Tutorial	Recall the techniques	Discussion	BY 1402 1/	
		of chromatography		BY 1402.6	Quiz
35	Centrifugation: principle	Learn separation of	Lecture	BY 1402.6	Quiz
		biomolecules on density		21 102.0	End Term
36	Types of Centrifuge	Learn separation of	Lecture	BY 1402.6	Quiz
		biomolecules on density	Lecture	BT 1102.0	End Term
		Learn separation of			
		biomolecules on density			
37.	Different types of rotors and	Learn separation of	Lecture	BY 1402.6	Quiz
	applications of centrifuge	biomolecules on density			End Term
38.	Tutorial	Recall density based	Discussion	BY 1402.6	Class test/
		separation			Quiz

39.	Autoradiography and principle	Learn techniques of nucleic acid visualization	Lecture	BY 1402.6	Quiz End Term
40.	Autoradiography and its applications	Learn techniques of nucleic acid visualization	Lecture	BY 1402.6	Quiz End Term
41.	Tutorial	Recall the techniques leant	Discussion	BY 1402.6	Class test/ Quiz
Lab Sessions	Working principles of various available laboratory instruments: Laminar Air Flow Cabinet, centrifuge, spectrophotometer, oven, incubator, BOD incubator, autoclave. Study of UV absorption spectra of macromolecules (protein and nucleic acid). Determination of Lambda max of a dye solution. Determination of protein and nucleic acid concentration by spectrophotometric method. Separation and identification of amino acids using TLC.	Learn various techniques	Lab sessions	BY 1402.1 BY 1402.2 BY 1402.6	Experimental results lab sessions End Term Practical Examination

		CORR	ELATIC	DN WIT	'H PRO	GRAM	OUTCO	omes		CORF	RELATIO	DN WI	TH PRO	GRAM	SPECIFI	C OUT	COMES	
со	STATEMENT	PO	PO	PO	PO	PO	PO	PO	PSO	PSO	PSO	PSO	PSO	PSO	PSO	PSO	PSO	PSO
		Ι	2	3	4	5	6	7	1	2	3	4	5	6	7	8	9	10
[BY	State the principle of various	Ι											3					
402.]	analytical instruments used in																	
	life sciences for analysis of																	
	different biological samples																	
[BY	Explain the working of different	Ι											3					
I 402.2]	types of biological instruments																	
FDV													`					
	Apply different biological	1											3					
1402.3	techniques for analysing																	
	different types of biological																	
	samples					-							2					
	Distinguisn between different	1											3					
1402.4]	types of spectrophotometric																	
	and electrophoretic techniques					-							2					
	Select appropriate technique for	1											3					
1402.5]	analysing different types of																	
	samples such as biomolecules,																	
	plant and animal tissues, etc	1											3					
	activity of different	1											5					
1402.0]	biomoloculos																	
	sportrophotometric using																	
	spectrophotometric,																	
	microscopic tochniquos																	
FRY	lise the different tools and	1											3					
	knowledge of analytical	'											5					
	techniques to increase																	
	employability skills																	



School of Basic Science

Department of Chemistry Course Hand-out

Chemistry of Biomolecules CY 1513 | 4 Credits | 3 1 0 4

Session: July 18 – Nov 18 | Faculty: Dr Meenakshi Pilania | Class: Core subject, BSc (Hons, Vth semester)

- A. Introduction: This course is offered by Department of Chemistry as a core subject for the B.Sc. programme to provide information about biochemically important molecules like amino acids, proteins, carbohydrates, nucleic acids and lipids. This course offers biological processes such as protein biosynthesis, DNA replication and the relationship in between biochemistry and cellular biology.
- **B.** Course Outcomes: At the end of the course, students will be able to
 - [1513.1]. To provide information about biochemically important aspects of the chemistry of amino acids and carbohydrates using appropriate examples.
 - [1513.2]. Develop the skills of the basic principle of nucleic acid and proetins.
 - [1513.3]. To understand various metabolism reactions like carbohydrate, lipid, amino acid
 - [1513.4]. To acquire the knowledge of biochemistry at atomic level.
 - [1513.5]. Identify different types of natural products, their occurrence, structure, biosynthesis and properties.

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

- [PO.1]. Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.
- [PO.2]. Effective Communication: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.
- [PO.3]. Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.
- [PO.4]. Effective Citizenship: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.
- [PO.5]. Ethics: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.
- [PO.6]. Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.

[PO.7]. Environment and Sustainability: Understand the issues of environmental contexts and sustainable development. Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes.

- [PSO.1]. Recognize and apply the fundamental concepts of chemistry and their applications.
- [PSO.2]. Employ critical thinking and scientific inquiry in the interpretation of theoretical knowledge at a level suitable to succeed at an entry-level position in chemical industry or a post graduate chemistry program.
- [PSO.3]. Understand the applications of chemical sciences in the areas of organic synthesis, synthesis of materials, corrosion inhibition, environment sustainability etc.

D. Assessment Plan:

Criteria	Description	Maximum Marks

	Sessional Exam I (Closed Book)	20
Internal Assessment	Sessional Exam II (Closed Book)	20
(Summative)	Assignments , Activity feedbacks	10
	(Accumulated and Averaged)	
End Term Exam	End Term Exam (Closed Book)	50
(Summative)		
	Total	100
Attendance	A minimum of 75% Attendance is require	red to be maintained by a student to be
(Formative)	qualified for taking up the End Semest	er examination. The allowance of 25%
	includes all types of leaves including medi	cal leaves.
Make up Assignments	Students who misses a class will have to	report to the teacher about the absence.
(Formative)	A makeup assignment on the topic taught	on the day of absence will be given which
	has to be submitted within a week from t	he date of absence. No extensions will be
	given on this. The attendance for that p	particular day of absence will be marked
	blank, so that the student is not accour	nted for absence. These assignments are
	limited to a maximum of 5 throughout th	e entire semester.
Homework/ Home Assignment/	There are situations where a student may	y have to work in home, especially before
Activity Assignment	a flipped classroom. Although these work	s are not graded with marks. However, a
(Formative)	student is expected to participate and per	form these assignments with full zeal since
	the activity/ flipped classroom participation	on by a student will be assessed and marks
	will be awarded.	

E. SYLLABUS

Carbohydrates: Classification and nomenclature, Monosaccharides, mechanism of ozone formation, interconversion of glucose and fructose, Configuration of monosaccharides, Conversion of glucose into mannose. Formation of glycosides, ethers and esters, Cyclic structure of D(+)-glucose, mutarotation, Structures of ribose and deoxyribose. An introduction to disaccharides and polysaccharides; **Amino Acids, Peptides, Proteins Nucleic Acids, Lipids, Terpines and Terpeniods:** Classification, structure and stereochemistry of amino acids. Acid-base behavior, isoelectric point and electrophoresis. Preparation and reactions of α -amino acids. Structure and nomenclature of peptides and proteins. Classification of proteins, Classical peptide synthesis, solidphase peptide synthesis, Structures of peptides and proteins. Protein denaturation, Nucleic acids.

F. TEXT BOOKS

- 1. D.L. Nelson, M.M. Cox, Lehninger's Principles of Biochemistry, W. H. Freeman, 2011.
- 2. J.M. Berg, J.L. Tymoczko, and L. Stryer, *Biochemistry*, W. H. Freeman, 2009.

G. REFERENCE BOOKS

1. L.Stryer, Biochemistry, W.H. Freeman and Company, 4th edition, New York, 2012

H. Lecture Plan:

LEC NO	TOPICS
1	Introduction and Course Hand-out briefing
2,3	Chemistry of biomolecules basic aspects of structure
4-6	Carbohydrate: Classification of carbohydrates, method of preparation
7-9	Mechanism of ozone formation, interconversion of glucose and fructose,
10-12	Formation of glycosides, ethers and esters
13-16	Cyclic structure of D(+)-glucose, mutarotation, Structures of ribose and deoxyribose
17-18	disaccharides and polysaccharides
19	Amino acid: Introduction, classification, Stereochemistry
20-21	Proteins: Introduction, classification based on structure and Prosthetic group
22	Color test for protein, separation of proetin
23	Lipid: Introduction, classification, Synthesis, triglycerides
24-25	Saponification valus, Rancidity, iodine value
26-28	Nucleic acids: Structure, Base component, Sugar, Phosphate group
29-32	Polynucleotide, Polynucleoside
33-36	Classical peptide synthesis, solidphase peptide synthesis
37-39	Natural Products: Introduction
40-42	Terpines and Terpeniods: Introduction, Isoprene rule, classification
43	Monoterpene: Geranial synthesis (acyclic)
44	Monoterpene: α-Terpenol synthesis (monocyclic)
45	Revision
46-48	Revision

			COR	RELATIO	N WITH PF	Rogram (DUTCOMES	1	CORRELAT	FION WITH PRO	JGRAM
СО	STATEMENT						SPECIFIC OUTCOMES				
	STATEMENT	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3
CY1513.1	To provide information about biochemically	3						3	3	2	1
	important aspects of the chemistry of amino acids and										
	carbohydrates using appropriate examples.										
CY1513.2	Develop the skills of the basic principle of nucleic	3						3	2	2	3
	acid and proetins.										
CY1513.3	To understand various metabolism reactions like	3						3	3	2	2
	carbohydrate, lipid, amino acid										
CY1513.4	To acquire the knowledge of biochemistry at atomic	3						3	3	2	2
	level										
CY1513.5	Identify different types of natural products, their	3						3	3	2	2
	occurrence, structure, biosynthesis and										
	properties.										

I- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

J. Course Outcome Attainment Level Matrix:

со	STATEMENT	ATTAINMENT OF PROGRAM OUTCOMES THRESHOLD VALUE: 35% ATTAINMENT OF PROGRAM SPECIFIC OUTCOMES						ROGRAM ES			
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3
CY1513.1	To provide information about biochemically important aspects of the chemistry of amino acids and carbohydrates using appropriate examples.	3.00						3.00	3.00	2.00	3.00
CY1513.2	Develop the skills of the basic principle of nucleic acid and proetins.	3.00						3.00	3.00	2.00	3.00
CY1513.3	To understand various metabolism reactions like carbohydrate, lipid, amino acid	3.00						3.00	3.00	2.00	3.00
CY1513.4	To acquire the knowledge of biochemistry at atomic level	3.00						3.00	3.00	2.00	3.00
CY1513.5	Identify different types of natural products, their occurrence, structure, biosynthesis and properties.	2.00		0.00	0.00	0.00		2.00	2.00	1.33	2.00



School of Basic Sciences

Department of Chemistry Course Hand-out

Green Chemistry | CY1515 | 3 Credits | 2103

Session: Jul. 18 – Dec 18 | Faculty: Dr. Sriparna Ray | Class: 5th Semester B. Sc. (Chemistry Hons.)

- A. Introduction: This course is offered by Dept. of Chemistry for 5th Semester B. Sc. (Chemistry Hons.) students. The objective of the course is to acquain the students with the basic concepts of Green chemistry. This course is an opportunity for introducing innovative solutions to chemical problems and applying sustainability towards molecular design. Improved design of products and processes will reduce the harmful impacts on humans and the environment and therefore creating sustainable chemical building blocks for materials and products in our society.
- B. Course Outcomes: At the end of the course, students will be able to
 [CY1515.1] Be aware of the current status and new developments in Green Chemistry
 [CY1515.2] Know the different principles on which Green Chemistry is based
 [CY1515.3] Understand the impact of Green Chemistry on environment and imbibe the concept of sustainable development
 [CY1515.4] Recognise the products and processes benign to health and environment with respect to skills and knowledge to green chemistry

[CY1515.5] Predict which methods are sustainable and can be applied in future for better employability

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

- [PO.1]. Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.
- [PO.2]. Effective Communication: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.
- [PO.3]. Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.
- [PO.4]. Effective Citizenship: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.
- [PO.5]. Ethics: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.
- [PO.6]. Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.
- [PO.7]. Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes
- [PSO.1] Recognize and apply the fundamental concepts of chemistry and their applications.
- [PSO.2] Employ critical thinking and scientific inquiry in the interpretation of theoretical knowledge at a level suitable to succeed at an entry-level position in chemical industry or a post graduate chemistry program.
- [PSO.3] Understand the applications of chemical sciences in the areas of organic synthesis, synthesis of materials, corrosion inhibition, environment sustainability etc. Apply these principles both in simple exercises and in more complex problems of Chemistry.

D. Assessment Plan:

Criteria	Description	Maximum Marks						
	Sessional Exam I	20						
Internal Assessment	Sessional Exam II	20						
(Summarve)	In class Quizzes and Assignments , Activity feedbacks (Accumulated and Averaged)	10						
End Term Exam	End Term Exam	50						
(Summative)								
	Total	100						
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.							
Make up Assignments (Formative)	Students who miss a class will have to report to the teacher about the absence A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this. The attendance for that particular day of absence will be marked blank, so that the student is not accounted for absence These assignments are limited to a maximum of 5 throughout the entire semester.							
Homework/ Home Assignment/ Activity Assignment (Formative)	There are situations where a student may have to work in home, especial before a flipped classroom. Although these works are not graded with mar However, a student is expected to participate and perform these assignme with full zeal since the activity/ flipped classroom participation by a student we be assessed and marks will be awarded.							

E. SYLLABUS

Principles of Green chemistry-I: (i) Prevention of waste/byproducts. (ii) Maximum incorporation of materials used in process in to the final product (Atom economy): Green metrics (iii) Prevention/Minimization of hazardous/toxic products (iv) Designing safer chemicals-different basic approaches (v) selection of appropriate auxiliary substances (solvents, separation agents etc). (vi) Energy requirements for reactions-use of microwave, ultrasonic energy;

Principles of Green chemistry-II: (vii) Selection of stating materials-use of renewable starting materials. (viii) Avoidance of unnecessary derivation-careful use of blocking/protection groups (ix) use of catalytic reagents (wherever possible) in preference to stoichiometric reagents (x) Designing biodegradable products (xi) prevention of chemical accidents. (xii) Strengthening/development of analytical techniques to prevent and minimize the generation of hazardous substances in chemical processes. Development of accurate and reliable sensor and monitors for real time in process monitoring.

Example of Green synthesis/reaction: The chemistry behind Green Chemistry **Future trend in green chemistry**, biomimetic, multifunctional reagents, combinatorial green chemistry, biomass conversion, emission control, biocatalysts 1. V.K. Ahluwalia, *Green Chemistry: Greener Alternatives to Synthetic Organic Transformations*, Narosa Publishing House, 2011.

2. F. A. Carey and R. J. Sundberg, *Advanced Organic Chemistry: Reaction and Synthesis (Part B)*, Springer India Private Limited, 2007.

G. REFERENCE BOOKS

1. M. B. Smith, J. March, March's Advanced Organic Chemistry: Reactions, Mechanisms and Structure, Wiley, 2012.

H. Lecture Plan:

Lecture	Topics
1	Principles of Green chemistry-I: Introduction of Green Chemistry
2-3	(i) Prevention of waste/byproducts.
4-5	(ii) Maximum incorporation of materials used in process in to the final product (Atom
	economy): Green metrics
6-7	(iii) Prevention/Minimization of hazardous/toxic products
8-9	(iv) Designing safer chemicals-different basic approaches
10-11	(v) selection of appropriate auxiliary substances (solvents, separation agents etc).
12-14	(vi) Energy requirements for reactions-use of microwave, ultrasonic energy;
15-16	Principles of Green chemistry-II: (vii) Selection of stating materials-use of renewable
	starting materials.
17-18	(viii) Avoidance of unnecessary derivation-careful use of blocking/protection groups
19-20	(ix) use of catalytic reagents (wherever possible) in preference to stoichiometric
	reagents.
21-22	(x) Designing biodegradable products
23-24	(xi) prevention of chemical accidents
25-28	(xii) Strengthening/development of analytical techniques to prevent and minimize the
	generation of hazardous substances in chemical processes. Development of accurate
	and reliable sensor and monitors for real time in process monitoring.
29-31	Example of Green synthesis/reaction
32-33	The chemistry behind Green Chemistry
34-35	Future trend in green chemistry, biomimetic, multifunctional reagents,
36-38	combinatorial green chemistry, biomass conversion,
39-40	emission control, biocatalysts
41-42	Revision

со	STATEMENT		ORRELA	TION W	CORRELATION WITH PROGRAM SPECIFIC OUTCOMES						
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3
[CY1515.1]	Be aware of the current status and new developments in Green Chemistry		3	2				3			1
[CY1515.2]	Know the different principles on which Green Chemistry is based		3					2	3		
[CY1515.3]	Understand the impact of Green Chemistry on environment and imbibe the concept of sustainable development	3			1	1	3	2	2	3	3
[CY1515.4]	Recognise the products and processes benign to health and environment with respect to skills and knowledge to green chemistry	3	2	1			3	2	1	3	
[CY1515.5]	Predict which methods are sustainable and can be applied in future	3	1		1		3	2	1	3	2

I- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

J. Course Outcome Attainment Level Matrix:

со	STATEMENT	ATTAINMENT OF PROGRAM OUTCOMES THRESHOLD VALUE: 40%								ATTAINMENT OF PROGRAM SPECIFIC OUTCOMES				
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3	PSO 4		
[CY1515.1]	Be aware of the current status and new developments in Green Chemistry													
[CY1515.2]	Know the different principles on which Green Chemistry is based													
[CY1515.3]	Understand the impact of Green Chemistry on environment and imbibe the concept of sustainable development													
[CY1515.4]	Recognise the products and processes benign to health and environment with respect to skills and knowledge to green chemistry													
[CY1515.5]	Predict which methods are sustainable and can be applied in future													

0-No Attainment; I- Low Attainment; 2- Moderate Attainment; 3- Substantial Attainment

School of Basic Sciences

Department of Chemistry Course Hand-out

Nuclear and Analytical Chemistry | CY1516 | 3 Credits | 2 1 0 3

Session: Jul 18 – Nov 18 | Faculty: Arunava Agarwala | Class: 5th Semester B. Sc. (Chemistry Hons.)

- A. Introduction: This course is offered by Dept. of Chemistry for 5th Semester B. Sc. (Chemistry Hons.) students. The objective of the course is to acquaint the students with the fundamental aspects of nuclear chemistry and analytical chemistry. Students will have a firm foundation in the fundamentals and application of current chemical and scientific theories in nuclear and analytical chemistries.
- B. Course Outcomes: At the end of the course, students will be able to
 - **[CY1516.1].** Describe nuclear structure, stable and unstable atomic nuclei, nuclear reactions and different modes of radioactive decay.
 - **[CY1516.2].** Develop skill in calculations applied in analytical chemistry, be able to calculate errors for method evaluation, and perform statistical evaluation of results from classical and instrumental chemical experiments and analyses.
 - **[CY1516.3].** Design classical analytical experiments, and make observations and assessments of important factors that could affect the analytical result.
 - **[CY1516.4].** Explain the theoretical principles and important applications of classical analytical methods within titration (acid/base titration, complexometric titration, redox titration), and various techniques within gravimetric methods.
 - **[CY1516.5].** Develop skill in selected instrumental methods within spectrometric/spectrophotometric methods, and main components in such analytical instruments.
 - **[CY1516.6].** Explain the theoretical principles of some separation techniques and typical applications of these techniques.

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

- [PO.1]. Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives
- [PO.2]. Effective Communication: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology
- [PO.3]. Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.
- [PO.4]. Effective Citizenship: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informedawareness of issues and participate in civic life through volunteering.
- [PO.5]. Ethics: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility forthem.
- [PO.6]. . Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.
- [PO.7]. Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context socio-technologicalchanges
- [PSO.1]. Recognize and apply the fundamental concepts of chemistry and their applications.
- [PSO.2]. Employ critical thinking and scientific inquiry in the interpretation of theoretical knowledge at a level suitable to succeed at an entry-level position in chemical industry or a post graduate chemistry program.
- [PSO.3]. Understand the applications of chemical sciences in the areas of organic synthesis, synthesis of materials, corrosion inhibition, environment sustainability etc. Apply these principles both in simple exercises and in more complex problems of Chemistry

D. Assessment Plan:

Criteria	Description	Maximum Marks							
	Sessional Exam I (Closed Book)	20							
Internal Assessment	Sessional Exam II (Closed Book)	20							
(Summative)	Assignments and Class tests	10							
	(Accumulated and Averaged)								
End Term Exam	End Term Exam (Closed Book)	50							
(Summative)									
	Total	100							
Attendance	A minimum of 75% Attendance is requir	ed to be maintained by a student to be							
(Formative)	qualified for taking up the End Semest	er examination. The allowance of 25%							
	includes all types of leaves including med	ical leaves.							
Homework/ Home Assignment/ Activity	There are situations where a student ma	y have to work in home. Although these							
Assignment	works are not graded with marks. However, a student is expected to partici								
(Formative)	and perform these assignments with full zeal since the activity will help the								
	students in developing better understand	ling.							

E. SYLLABUS

Nuclear Chemistry: Introduction to Atomic Nucleus, Radioactive Decay; α , β and γ , Nuclear Stability, Liquid drop Model and Shell model, Nuclear Reactions, Nuclear Fission and Fusion; Elementary Concepts of Analytical Chemistry: Qualitative and quantitative analysis, concepts important to quantitative analysis classification of methods for quantitative analysis, choice of method for analysis, sampling and theories of sampling, Preparation of samples for analysis, calibration standards, solution concentration in terms of various conventions, simple equilibrium calculations; Volumetric and Gravimetric Methods of Analysis: Theory of volumetric and gravimetric methods of analysis, equivalent points, standard solutions, Primary and Secondary standards, end point detection, optimum conditions for precipitation, washing and filtration of precipitates, Determination of inorganic salts in mixtures, Introduction to DSC, TGA, DTA; Acid-Base Equilibria: Preparation of standard solutions of acids and bases, mono and poly functional acids and bases and their pH titration curves, typical applications of neutralization titrations in elemental analysis; Precipitation Equilibria: Solubility of precipitates, effect of competing equilibria on solubility of precipitates, separation of ions by control of concentration of precipitating reagents, effect of electrolyte concentration on solubility, solubility product; Complexation Equilibria: Complexation, Formation constants, EDTA equilibria, Use of indicators, Applications of complexometric equilibria; Solvent Extraction and Ion-Exchange Separation: Basic principles of solvent extraction, solvent extraction of metals, extraction process, separation efficiency of metal chelates, ion-exchange processes, ion-exchange resins, techniques and applications of ion-exchange separation; Atomic Spectrometric Methods: Emission spectroscopy, Flame emission spectrometry Plasma emission spectrometry, Distribution between ground and excited states, Atomic absorption spectrophotometry.

F. TEXT BOOKS

A book or a set of books which covers 60% or more of the syllabus can be written under this category. (Not more than 3)

- 1. Lee, J. D.; Concise Inorganic Chemistry. John Wiley & Sons, 2010. (Nuclear Chemistry)
- 2. Day, Jr. R. A.; Underwood, A. L.; Quantitative Analysis, Pearson Education India; 6th edition (2015)

G. REFERENCE BOOKS

- 1. Arnikar, H. J.; Essentials of Nuclear Chemistry New Age International Private Limited; 4th edition (2011).
- 2. Christian Gary D.; Analytical Chemistry Wiley; 6th edition (2007)

Н. Lecture Plan:

Lecture number	Topics
1	Nuclear Chemistry: Introduction to atomic nucleus
2	Structures of the nucleus: Liquid drop model, shell model
3	Forces in the nucleus; Stability of nucleus and the ratio of neutrons to protons.
4	Models of decay: Beta emission, neutron emission, positron emission, orbital or K- electron capture, proton emission.
5	Gamma radiation, half life period, binding energy and nuclear stability, Alpha decay.
6	Radioactive displacement laws and radioactive decay series
7	Nuclear fission reaction: Chain reaction, Critical mass.
8	The story of production of the atomic bomb; separation of isotopes; Nuclear power stations.
9	Nuclear fusion reaction: Thermonuclear weapons; Controlled fusion reactions.
10	Applications of radioactive isotopes.
11	Analytical Chemistry: Introduction, qualitative and quantitative analysis, concepts important to quantitative analysis classification of methods for quantitative analysis
12	Theories of sampling, Preparation of samples for analysis, calibration standards, solution concentration in terms of various conventions,
13	Preparation of samples for analysis, calibration standards, solution concentration in terms of various conventions
14	Simple equilibrium calculations
15	Volumetric Methods of Analysis: Theory of volumetric of analysis, equivalent points, standard solutions, Primary and Secondary standards, end point detection
16	Volumetric Methods of Analysis: Theory of volumetric of analysis, equivalent points, standard solutions, Primary and Secondary standards, end point detection (contd.)
17	Gravimetric Methods of Analysis: Theory of gravimetric methods of analysis, optimum conditions for precipitation, washing and filtration of precipitates
18	Gravimetric Methods of Analysis: Theory of gravimetric methods of analysis, optimum conditions for precipitation, washing and filtration of precipitates (contd.)
19	Some examples of gravimetric analysis of mixtures.
20	Introduction to analytical methods: DSC, TGA, DTA.
21	Working principle of and basic instrumentation of DSC, TGA, DTA.
22	Acid-Base Equilibria: Preparation of standard solutions of acids and bases, mono and poly functional acids and bases.
23	Acid-Base Equilibria: Indicators used in Acid-Base titration, pH titration curves, Some applications of pH titration

24	Precipitation Equilibria: Solubility of precipitates, effect of competing equilibria on solubility of precipitates.
25	Precipitation Equilibria: separation of ions by control of concentration of precipitating
	reagents, effect of electrolyte concentration on solubility and solubility product.
26	Complexation Equilibria: Complexation, Formation constants, EDTA equilibria, Use of
	indicators, Applications of complexometric equilibria
27	Complexation Equilibria: Conditions for complex formation; Use of indicators in
	complexometric titration;
28	Applications of complexometric titration.
29	Solvent Extraction and Ion-Exchange Separation: Basic principles of solvent extraction,
	distribution coefficient.
30	Solvent extraction of compounds, separation efficiency
31	Solvent extraction of compounds, separation efficiency (Numerical problems)
32	Ion-exchange processes, ion-exchange resins, techniques and applications of ion-exchange
	separation
33	Spectrometric Methods: Basic principle for spectroscopy; Distribution between ground
	and excited states.
34	Beer–Lambert law; Numerical problems.
35	Instrumentation and application of UV-Vis spectrophotometer.
36	Emission spectroscopy
37	Atomic absorption spectrophotometry (AAS): Instrumentation.
38	Atomic absorption spectrophotometry (AAS:) Application
39	Revision.

I. Course Articulation Matrix: (Mapping of COs with POs)

		C	ORRE	LATIO	N WIT	TH PRO	DGRA	CORRELATION WITH PROGRAM				
СО	STATEMENT			OU	TCON	/IES			SPECIFIC OUTCOMES			
		PO	PO	PO	РО	PO	PO	PO	PSO 1	PSO 2	PSO 3	
		1	2	3	4	5	6	7				
CY	Course Outcome	1	1	2	1				1			
1313.1	statement											
CY	Course Outcome	2			1					2		
1313.2	statement											
CY	Course Outcome	1					1				3	
1313.3	statement											
CY	Course Outcome	2								1		
1313.4	statement											
CY	Course Outcome	1		1			2		2			
1313.5	statement											
CY	Course Outcome	1									2	
1313.6	statement											

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

J. Course Outcome Attainment Level Matrix:

<u> </u>			ATTA		ATTAINMENT OF								
0	STATEMENT			IH	KE2H		ALUE	: 40%					
						SPECIFIC							
			1	1	OUTCOMES								
		PO	PO	PO	PO	PO	PO	PO 7	PO	PO	PSO	PSO	PSO
		1	2	3	4	5	6		8	9	1	2	3
CY	Course Outcome												
1313.1	statement												
CY	Course Outcome												
1313.2	statement												
CY	Course Outcome												
1313.3	statement												
CY	Course Outcome												
1313.4	statement												
CY	Course Outcome												
1313.5	statement												
CY	Course Outcome												
1313.6	statement												

0-No Attainment; 1- Low Attainment; 2- Moderate Attainment; 3- Substantial Attainment



School of Basic Sciences

Department of Mathematics & Statistics Course Hand-out

Real Analysis | MAI5II | 4 Credits | 3 | 0 4

Session: July 2018– Dec 18 | Faculty: Dr. Virendra Singh Chouhan | Class: B.Sc. (Pass) (Mathematics) V sem.

A. Introduction:

Dept. of Mathematics & Statistics offer the course Real Analysis for B.Sc. (Pass) Mathematics Students. The aim of this course to motivate students to develop research ability in students by theoretical approach and create interest in pure mathematics. The course will develop a depth understanding of Real Analysis by some concept of Analysis like Real numbers, Real sequences, Infinite series, Improper Integrals. The course will develop mental ability in problem solving.

B. Course Outcomes: At the end of the course, students will be able to

- [1511.1] Enhance the concept of real line in terms of rational, irrational, real numbers etc.
- [1511.2] Improve the skill on real line to find the neighbourhood, interior point, open set, limit point, closed set, Concept of compactness and Connected set.
- [1511.3] Developed the skill to find convergence and divergence of sequence and series by using different types of tests.
- [1511.4] Developed the skill to find convergence and divergence of improper integral and Beta & Gamma function.
- [1511.5] Enhance the concept of Differentiation and integration of a function under the sign of integral.

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

[PO1] Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.

[PO2] Effective Communication: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.

[PO3] Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.

[PO4] Effective Citizenship: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

[PO5] Ethics: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.

[PO6] Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.

[PO7] Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes

[PSO.1] To understand the basic principles and apply these principles both in simple exercises and in more complex problems of advanced study.

[PSO.2] To Understand and apply the fundamental concepts of Sciences, employ critical thinking and scientific queries at a suitable level to get success in Professional domain and / or Higher Studies.

[PSO.3] To understand the Mathematical applications in science & Technology.

Criteria	Description	Maximum Marks							
	Sessional Exam I (Closed	20							
Internal Assessment	Book)								
(Summative)	Sessional Exam II (Closed	20							
	Book)								
	In class Quizzes and	10							
	Assignments , Activity								
	feedbacks (Accumulated and								
	Averaged)								
End Term Exam	End Term Exam (Closed Book)	50							
(Summative)									
	Total	100							
Attendance	A minimum of 75% Attendance	is required to be maintained by a							
(Formative)	student to be qualified for	taking up the End Semester							
	examination. The allowance of 25% includes all types of leaves								
	including medical leaves.								
Make up Assignments	Students who misses a class wi	ill have to report to the teacher							
(Formative)	about the absence. A makeup as	signment on the topic taught on							
	the day of absence will be given	which has to be submitted within							
	a week from the date of absence	. No extensions will be given on							
	this. The attendance for that pa	rticular day of absence will be							
	marked blank, so that the stude	nt is not accounted for absence.							
	These assignments are limited to	a maximum of 5 throughout the							
	entire semester.	1 . 1 . 1 . 1							
Homework/ Home Assignment/	There are situations where a stud	dent may have to work in home,							
Activity Assignment	especially before a flipped classroom. Although these works								
(Formative)	not graded with marks. However, a student is expected								
	participate and perform these assignments with full zeal sin								
	activity/ flipped classroom part	ticipation by a student will be							
	assessed and marks will be award	led.							

D. Assessment Plan:

E. SYLLABUS

Real Numbers: Real numbers as a complete ordered field, Limit point, Bolzano Weierstrass theorem, Closed and open sets, Union and intersection of such sets, Concept of compactness, Heine Borel theorem, Connected sets. **Sequence:** Real Sequences, Limit and convergence of a sequence, Monotonic sequences, Cauchy's sequence, Subsequence, Cauchy's general principle of convergence.

Infinite Series: Convergence of infinite series, Tests of convergence (with proof): Comparison test, Ratio test, Cauchy's root test, Raabe's test, Logarithmic test, Integral test, Cauchy's condensation test, Gauss's test, Alternating series, Leibnitz's theorem, Absolute and conditional convergence, Taylor's and Maclaurin's expansion of functions.

Improper Integrals: Convergence of improper integrals and their properties, Convergence of Beta and Gamma functions, Differentiation and integration of a function under the sign of integral.

F. TEXT BOOKS

- 1. Shanti Narayan, Elements of Real Analysis, S. Chand & Co., New Delhi, 2013.
- 2. S. C. Malik and S. Arora, Mathematical Analysis, New Age Int. Pub., New Delhi, 2010.

REFERENCE BOOKS

- 1. R. G. Bartle and D. R. Sherbert, Introduction to Real Analysis, John Wiley & Sons, 2000.
- 2. W. Rudin, Principles of Mathematical Analysis, 3rd Edition, McGraw Hill, New York, 2013.
- 3. H. L. Royden and P. M. Fitzpatrick, Real Analysis, 3rd Edition, Macmillan, New York, 2010.
- 4. T. M. Apostal, Mathematical Analysis, Addison-Wesley, 2008.

G. Lecture Plan:

LEC NO	TOPICS
1	Introduction about the subject
2	Real numbers
3,4	Real numbers as a complete ordered field
5	Limit point
6,7	Bolzano Weierstrass theorem
8,9	Closed and open sets
10,11	Union and intersection of such sets
12,3	Concept of compactness
14,15	Heine Borel theorem,
16,17	Connected sets
18	Real Sequences,
19,20,21	Limit and convergence of a sequence
22,23	Convergence of sequences; Limit point of a sequence
24	Monotonic sequences
25	Cauchy's sequence,
26	Subsequence
27	Cauchy's general principle of convergence
28	Convergence of infinite series
29, 30	Tests of convergence (with proof): Comparison test,
31,32,33	Ratio test, Cauchy's root test
34	Raabe's test,
35	Logarithmic test,
36,37,38	Integral test, Cauchy's condensation test
39,40,41	Gauss's test, Alternating series,
42	Taylor's expansion of functions
43	Maclaurin's expansion of functions
44	Convergence of improper integrals
45	properties
46	Convergence of Beta
47	Convergence of Gamma functions
48	Differentiation of a function under the sign of integral
49	integration of a function under the sign of integral

A. Course Articulation Matrix: (Mapping of COs with POs and PSOs):-

со	STATEMENT	С	ORRELA	TION WI	CORRELATION WITH PROGRAM OUTCOME							CORRELATION WITH PROGRAM SPECIFIC OUTCOME			
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3				
MA1511.1	Enhance the concept of real line in terms of rational, irrational, real numbers etc.	3		2	1										
MA1511.2	Improve the skill on real line to find the neighbourhood, interior point, open set, limit point, closed set, Concept of compactness and Connected set.	2	2				3								
MA1511.3	Developed the skill to find convergence and divergence of sequence and series by using different types of tests.		2			3		1							
MA1511.4	Developed the skill to find convergence and divergence of improper integral and Beta & Gamma function.			3				2							
MA1511.5	Enhance the concept of Differentiation and integration of a function under the sign of integral.			2	3		2								

1:-Low Correlation; 2:-Moderate Correlation; 3:- Substantial Correlation

B. Course Outcome Attainment Level Matrix:-

СО	STATEMENT		ATTAIN				TCOMES		ATTAINMENT OF PROGRAM			
		PO 1	PO1 PO2 PO3 PO4 PO5 PO6 PO7 P					PSO 1	PSO 2	PSO 3		
MA1511. 1	Understand the role of real line											
	in terms of rational, irrational,											
	real numbers etc.											
MA1511. 2	Use of real line to find the											
	neighbourhood, interior point,											
	open set, limit point, closed set,											
	Concept of compactness and											
	Connected set.											
MA1511.3	Find the convergence and											
	divergence of sequence and											
	series by using different types of											
	tests.											
MA1511. 4	Find the convergence and											
	divergence improper integral and											
	Beta & Gamma function											
MA1511. 5	Differentiation and integration of											
	a function under the sign of											
	integral.											

School of Basic Sciences

Department of Biosciences Course Hand-out

Plant Physiology BY 1501 | 3 Credits | 2 | 0 3

Session: 2018-2019 | Faculty: Dr. Jain Rohit | Class: V Semester

- A. Introduction: This course is offered by Dept. of Biosciences as a core course in B.Sc. (pass) Biotechnology, Botany/Bioscience, Chemistry/Psychology and, as a subsidiary course in B.Sc. (Hons) Biotechnology Programme targeting students who wish to pursue their career in the higher studies or research area of plant physiology and plant biochemistry. The course offers extensive knowledge of physiological behaviour of different plant under different environmental conditions. Understanding of mechanism of trapping sun light by the plant to prepare food and other useful metabolites and the mechanism of energy consumption are the main highlights of the course. Besides this, students will be able to learn the process of growth and development of plants and their movement. Students will also learn about the importance of relationship between soil, water and plants. Students are expected to have background knowledge of the common physiological processes such as diffusion, osmosis, transpiration, photosynthesis and respiration.
- **B. Course Outcomes:** At the end of the course, students will be able to:
 - **[BY 1501.1].** Define physiological mechanisms involved in the uptake and transport of water and the translocation of food by plants
 - **[BY 1501.2].** Identify mechanisms for procurement of mineral ions by plants and their role in biosynthesis of nutraceuticals
 - **[BY 1501.3].** Analysis of interrelationships among plants, micro-organisms, and environment with respect to various metabolic avtivities
 - **[BY 1501.4].** Relate different factors involved in water absorption (like DPD, OP, TP etc.) and the role of environmental factors in photosynthesis and their influence on carbon metabolism in plants
 - **[BY 1501.5].** Evaluate and quantify physiological and biochemical changes in plants under the influence of growth regulators (hormones)
 - **[BY 1501.6].** Develop novel strategies to achieve higher yield by modifying physiological and environmental factors thereby enhancing the skills for employability in horticulture and agronomy

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

- **[PO.I].** Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational and personal) from different perspectives.
- **[PO.2]. Effective Communication:** Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.
- **[PO.3].** Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.
- **[PO.4].** Effective Citizenship: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.
- **[PO.5].** Ethics: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.
- [PO.6]. Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.



- [PO.7]. Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes.
- **[PSO.1].** To demonstrate competency in factual content and interpretation of the major biological concept areas of cell and molecular biology, genetics, organismal biology, and evolution and ecology.
- **[PSO.2].** To demonstrate the ability to identify significant biological research questions, develop research protocols, and properly analyze research questions through the use of the scientific method.
- **[PSO.3].** Enhance analytical and quantitative skills and demonstrate an understanding of basic computational and statistical techniques in the field of Biotechnology

D. Assessment Plan:

Criteria	Description	Maximum Marks
	Mid Term Exam I – IA I	20
Internal Assessment	Mid Term Exam 2 - IA 2	20
(IA)	CWS Assessment IA 3	10
	10 marks of IA 3 are awarded based on the various	
	assignments, class tests, seminar presentation etc.	
End Term Exam (EX)	End Term Exam – EX I	50
	Total	100

NOTE: A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves

E. SYLLABUS

Plant cell-water relations, water and mineral absorption, transpiration, guttation, mineral nutritionessential micro and macro nutrients, deficiency of minerals; nitrogen metabolism. Photosynthesis: chloroplast structure, photosynthetic pigments, photosystems, photophosphorylation, Calvin cycle, C_4 pathway, CAM, photorespiration. Respiration: RQ, ATP- the biological energy currency, glycolysis, Kreb's cycle, Electron transport mechanism, oxidative phosphorylation, pentose phosphate pathway. Growth and development: Plant growth regulators- Auxins, Gibberellins, Cytokinins, Abscisic acid- general symptoms and their applications. Ethylene: biosynthesis, chemistry, its applications. Physiology of flowering: photoperiodism and vernalization, growth movements. Abscission and senescence.

F. TEXT BOOKS

- I. Verma, S.K. Plant Physiology and Biochemistry, S. Chand & Sons, New Delhi, 2012.
- 2. Devlin, R.M. Plant Physiology, East-West Press Pvt. Ltd. New Delhi, 1997.

G. REFERENCE BOOKS

- 1. Hopkins, W.G. Introduction to Plant Physiology, John Wiley & Sons Inc. New York, USA, 1995.
- 2. Taiz, L. and Zieger, E. Plant Physiology, Sinauer Associates, Inc., Publishers, Massachusetts, USA, 2010.

H. Lecture Plan:

Lecture	Торіс	Session Outcome	Mode of	Corresponding CO	Mode of assessing
	_		Delivery		the outcome
1.	Plant cell water relations	Understanding of	Lecture	BY 1501.4	MTE 1
	(TP,OP,WP,SP), physical properties of	Relationship of plants with			ETE
	water	environments			
2.	Water absorption	Understand the process of	Lecture	BY 1501.4	MTE 1
		water uptake by plants from			ETE
		soil			
3.	Tutorial	Discussion	Lecture	BY 1501.4	Class Test/Quiz
4.	Mineral absorption	Role of minerals on plant	Lecture	BY 1501.2	MTE 1
		growth and development			ETE
5.	Transportation of water and mineral	Role of minerals on plant	Lecture	BY 1501.1	MTE 1
		growth and development		BY 1501.2	ETE
6.	Tutorial	Discussion – Mineral	Lecture	BY 1501.1	Quiz
		Nutrition		BY 1501.2	
7.	Transpiration, Structure of stomata and	Mechanism of water	Lecture	BY 1501.4	MTE 1
	mechanism, factors affecting	transpiration from leaves		BY 1501.3	ETE
	Transpiration	and its importance			
8.	Guttation, comparison with		Lecture	BY 1501.4	MTE 1
	transpiration			BY 1501.3	ETE
9.	Tutorial	Discussion	Lecture	BY 1501.3	Class Test
				BY 1501.4	
10.	Mineral nutrition- essential micro and	Role of micro and macro	Lecture	BY 1501.2	MTE 1
	macro nutrients	nutrient in plant			ETE
		development			
11.	Deficiency of minerals and their effects	Deficiency diseases due to	Lecture	BY 1501.7	MTE 1
	in plants	mineral deficiency in plants			ETE
12.	Tutorial	Discussion	Lecture	BY 1501.2	Quiz
				BY 1501.7	
13.	Nitrogen metabolism	Metabolism of Nitrogen in	Lecture	BY 1501.2	MTE 2
		plants and fertility			ETE

14.	Photosynthesis: Photosynthetic	Role of photosynthesis in	Lecture	BY 1501.4	MTE 2
	pigment, Cholroplast structure	daily life			ETE
15.	Tutorial	Discussion	Lecture	BY 1501.2	MTE 2
				BY 1501.4	ETE
16.	Photosystems and their structure,	Photosynthesis in daily life	Lecture	BY 1501.3	MTE 2
	Mechanism of Photosynthesis,			BY 1501.4	ETE
17.	Photophosphorylation- Cyclic and non-	Mechanism of	Lecture	BY 1501.4	MTE 2
	cyclic photophosphorylation	photosynthesis in [plants			ETE
18.	Tutorial	Discussion	Lecture	BY 1501.4	Class Test
19.	Calvin Cycle (C4 cycle)	Synthesis of glucose in	Lecture	BY 1501.4	MTE 2
		plants			ETE
20.	Regulation of Calvin cycle,		Lecture	BY 1501.2	MTE 2
	Photorespiration				ETE
21.	Tutorial	Discussion	Lecture	BY 1501.7	Quiz
22.	CAM Cycle, Factors affecting rate of	Photosynthesis and its	Lecture	BY 1501.4	MTE 2
	Photosynthesis.	regulation in plants with			ETE
		environment			
23.	Respiration, RQ, ATP structure and	Respiration in energy	Lecture	BY 1501.1	MTE 2
	their functions	production			ETE
24.	Tutorial	Discussion	Lecture	BY 1501.1	Class Test
				BY 1501.4	
25.	Glycolysis and its regulation, Structure	Role of glycolysis in energy	Lecture	BY 1501.1	ETE
	and mechanism of Pyruvate	development			
	dehydrogenase complex.				
26.	Krebs (TCA) cycle and its regulation	Kreb cycle – production of	Lecture	BY 1501.1	ETE
		amino acids as secondary		BY 1501.2	
		products			
27.	Tutorial	Discussion	Lecture	BY 1501.1	Quiz
				BY 1501.2	
28.	Pentose Phosphate pathway and its	Alternate pathway of	Lecture	BY 1501.1	ETE
	regulation	respiration		BY 1501.2	
29.	Electron transport mechanism and	Energy production in cells	Lecture	BY 1501.1	ETE

	inhibitors, Oxidative Phosphorylation	by mitochondria by chemiosmosis theory		BY 1501.2	
30.	Plant Hormones: Auxin, general description and applications	Plant growth regulators – role in growth and regulation	Lecture	BY 1501.5	Assignment ETE
31.	Tutorial	Discussion	Lecture	BY 1501.1 BY 1501.2	ETE
32.	Gibberellin, general description and applications	Plant growth regulators – role in growth and regulation	Lecture	BY 1501.5	ETE
33.	Cytokinin and Abscisic acid, general description, synthesis, regulation and application	Plant growth regulators – role in growth and regulation	Lecture	BY 1501.5	ETE
34.	Tutorial	Discussion	Lecture	BY 1501.6 BY 1501.7	Class Test
35.	Ethylene, general description and applications	Plant growth regulators – role in growth and regulation	Lecture	BY 1501.5	ETE
36.	Abscission and Senescence: their mechanism and involved factors	Role of Senescence in removal of older parts	Lecture	BY 1501.5	ETE
37.	Tutorial	Discussion	Lecture	BY 1501.6 BY 1501.7	Class Test
38.	Physiology of flowering, Proteins involved in flowering and their function and signaling.	Flowering – mechanism of flowering in plants – ABC model	Lecture	BY 1501.6 BY 1501.7	Assignment ETE
39.	Photoperiodism: circadian rhythm. Proteins involved in photoperiodism.	Role of light in flowering	Lecture	BY 1501.6 BY 1501.7	ETE
40.	Vernalization and growth movements:Tactic and Nastic movements	Role of light in flowering Role of chemicals in growth and movements	Lecture	BY 1501.6 BY 1501.7	ETE
41.	Tutorial	Discussion	Lecture		

I. Course Articulation Matrix: (Mapping of COs with POs)

со	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES				CORRELATION WITH PROGRAM SPECIFIC OUTCOMES					
		PO 1	PO 2	РО 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3
[BY 1501.1].	Define physiological mechanisms involved in the uptake and transport of water and the translocation of food by plants								1		
[BY 1501.2].	Identify mechanisms for procurement of mineral ions by plants and mineral nutrition and the role these minerals play in organic molecule synthesis and use.								1		
[BY 1501.3].	Demonstrate interrelationships among plants and micro-organisms, symbiosis in nitrogen and phosphorous acquisition by plants						1		2		
[BY 1501.4].	Relate different factors involved in water absorption (like DPD, OP, TP etc.) and the role of environmental and plant factors in photosynthesis and influence upon carbon metabolism in plants (e.g. with respect to alternative fixation pathways photoinhibition, and photorespiration)	1									
[BY 1501.5].	Evaluate major effects on physiological and biochemical mechanisms of growth regulators (hormones) in plants	1							1	1	
[BY 1501.6].	Develop novel strategies to achieve higher yield by modifying physiological and environmental factors thereby enhancing the skills for employability in horticulture and agronomy									1	

I- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation



Department of Biosciences Course Hand-out

Plant Breeding| BY 1502 | 3 Credits | 2 | 0 3

Session: 2018-19 | Faculty: Dr. Sharma Madan Mohan| Class: V Semester

- A. Introduction: This course is offered by Dept. of Biosciences as a core course in B.Sc. (pass) Biotechnology, Botany/Bioscience, Chemistry/Psychology and, as a subsidiary course in B.Sc. (Hons) Biotechnology Programme targeting students who wish to pursue their career in the higher studies or research area of Agricultural Biology and Plant Breeding. The course offers extensive knowledge of breeding methodologies for development of high yielding and disease resistant varieties to feed the increasing population. In addition, the course will also cover basic introductory concepts to Biotech crops, gene technologies for crop improvement, molecular markers, marker assisted breeding, transgenic approach of plant improvement. Students are required to have prior knowledge of basic concepts of plant breeding and gene pool.
- **B. Course Outcomes**: At the end of the course, students will be able to

Understand the scope of plant breeding and developmental concepts of gene pool and primary origin of the important crops.

Discuss the importance of mass selection, hybridization and pure line selection for development of improved crop varieties.

Demonstrate the process of hybrid vigour and inbreeding depression and its practical application in crop improvement programs.

List the renowned plant breeders of India and their work in the field of plant breeding.

Apply the process of genotyping and phenotyping using Hardy-Weinberg's equilibrium in agri-crops

Describe mode of pollination, fertilization, and reproduction affects the ability to manipulate genetic variation and develop new varieties which will generate employability

Investigate the pattern of heredity using the laws of population genetics in the field grown crops for better production.

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

- **[PO.I].** Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational and personal) from different perspectives.
- **[PO.2]. Effective Communication:** Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.
- **[PO.3].** Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.
- **[PO.4]. Effective Citizenship:** Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.
- **[PO.5].** Ethics: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.
- [PO.6]. Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.
- **[PO.7].** Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes.



- **[PSO.1].** To demonstrate competency in factual content and interpretation of the major biological concept areas of cell and molecular biology, genetics, organismal biology, and evolution and ecology.
- **[PSO.2].** To demonstrate the ability to identify significant biological research questions, develop research protocols, and properly analyze research questions through the use of the scientific method.
- **[PSO.3].** Enhance analytical and quantitative skills and demonstrate an understanding of basic computational and statistical techniques in the field of Biotechnology

D. Assessment Plan:

Criteria	Description	Maximum Marks
	Mid Term Exam I – IA I	20
Internal Assessment	Mid Term Exam 2 - IA 2	20
(IA)	CWS Assessment IA 3	10
	10 marks of IA 3 are awarded based on the various	
	assignments, class tests, seminar presentation etc.	
End Term Exam (EX)	End Term Exam – EX I	50
	Total	100

NOTE: A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leave

E. SYLLABUS

History, introduction and scope of plant breeding, methods of plant breeding: selection, pedigree analysis, acclimatization, hybridization, heterosis and inbreeding depression. Renowned Indian and international plant breeders. Contributions of National and International institutes of plant breeding and centers for plant breeding. Brief account of mass selection, pure line and clonal selection, mutation and polyploidy breeding. Molecular marker systems: identification, utilization and integration in plant breeding programs.

F. TEXT BOOKS

- 1. Singh, B.D. Plant Breeding, Kalyani Publishers, New Delhi, 2011.
- 2. Gupta, P.K.. Genetics and Plant Breeding, Rastogi Publications, Meerut, 2011.

G. REFERENCE BOOKS

- I. Allard, R.A. Principles of Plant Breeding, John Wiley & Sons, New York, 1999.
- 2. Acquaah, G. Principles of Plant Genetics and Breeding, Wiley Blackwell, New York, 2012.

Lecture	Торіс	Session Outcome	Mode of Delivery	Corresponding CO	Mode of assessing the outcome
1.	History of Plant Breeding in India	Define plant breeding and look at its historical events in the India	Lecture	BY 1502.1	MTE I Test ETE
2.	Nature and Scope of plant breeding	Understand the scopes of plant breeding	Lecture	BY 1502.1	MTE I Quiz ETE
3.	Tutorial	Discussion/ interaction about the various scopes and objectives of plant breeding	Discussion	BY 1502.1	MTE I Quiz ETE
4.	Objectives of Plant Breeding	Overview about the Various objectives	Lecture	BY 1502.2	Test/Quiz
5.	Various activities in plant breeding: brief introduction about domestication, and germplasm collection	Understand about overall activities in plant breeding to produce and release a improved variety in the market	Lecture	BY 1502.2	Assignment MTE I ETE
6.	Tutorial	Discussion/ interaction with students about the queries related to the topics covered	Discussion	BY 1502.2	MTE I ETE
7.	Centre of origin of plants	Understanding the various centres of origin of crop plants overall world	Lecture	BY 1502.2	MTE I Quiz ETE
8.	Plant introduction and Introduction agencies in India, quarantine, applications	Explain the introduction of plants and identify the agencies involved in this process	Lecture	BY 1502.2	Test/Quiz
9.	Tutorial	Discussion/ interaction with students/ problem solving	Discussion	BY 1502.2	MTE I Quiz ETE
10.	Merits and demerits of plant introduction	Interpret merits and demerits of plant introduction	Lecture	BY 1502.2	MTE I Test ETE
11.	Methods of plant breeding: Selection, pedigree analysis, acclimatization, hybridization, heterosis and inbreeding depression	Schedule/execute the various steps of methodology in plant breeding	Lecture	BY 1502.3	MTE I Test ETE
12.	Tutorial	Interaction/ problem solving of the problems related to plant introduction and methods of plant breeding	Discussion	BY 1502.2 BY 1502.3	Test/Quiz
13.	Bases of plant selection for plant breeding	Apply the selection criteria of plants to improve plant variery	Lecture	BT1502.3	MTE 2 Quiz ETE
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14.	pedigree analysis and its applications	Implementation of pedigree method	Lecture	BT1502.3	MTE 2 Test ETE
15.	Tutorial	Discussion about the queries and its solutions	Discussion	BY 1502.3	MTE 2 Test ETE
16.	acclimatization, hybridization,	Execute the process of acclimatization and hybridization methods to produce improved varieties	Lecture	BY 1502.3	Test/Quiz
17.	Hardy Weinberg Law	Apply Hardy Weinberg Law to understand the genetic structure of plant populations	Lecture	BY 1502.3 BY 1502.5 BY 1502.7	MTE 2 Assignment ETE
18.	Tutorial	Solutions of the problems related to topics covered	Discussion	BY 1502.3 BY 1502.5 BY 1502.7	MTE 2 Test ETE
19.	heterosis, inbreeding depression	Apply the heterosis process to develop the superior plants and reduce the chances of inbreeding depression	Lecture	BY 1502.3	MTE 2 Quiz ETE
20.	Renowned Indian plant breeders. Contributions of National institutes of plant breeding and centres for plant breeding: development of improved varieties of crops	Analyse the research done at various research institutes at national Level	Lecture	BY 1502.4	Test/Quiz
21.	Tutorial	Discussion about the developed various hybrid plant variety	Discussion	BY 1502.3 BY 1502.4	MTE 2 Test ETE
22.	Renowned international plant breeders. Contributions of International institutes of plant breeding: examples of improved varieties of crops	Analyse the applications of International institutes of plant breeding for improved variety	Lecture	BY 1502.4	MTE 2 Quiz ETE
23.	mass selection: methodology	Apply the methods of mass selection to develop hybrid variety	Lecture	BY 1502.2	MTE 2 Assignment ETE
24.	Tutorial	Solutions of the problems related to topics covered	Discussion	BY 1502.2 BY 1502.4	Test/Quiz
25.	pure line selection: methodology	Examine the pure line selection methodology	Lecture	BY 1502.2	Quiz ETE

26.	Comparison of mass and pure line	Differentiate both the mass and pure	Lecture	BY 1502.2	Test ETE
	selection	line selection	_		
27.	Tutorial	Problem solving	Discussion	BY 1502.2	Assignment ETE
28.	clonal selection for plant improvement	Apply the clonal selection criteria to develop improved plant variety	Lecture	BY 1502.2	Test/Quiz
29.	Mutation: types based on the effect on protein and DNA	Implement mutagenesis to create mutagens in crop plant improvement	Lecture	BY 1502.6	Test ETE
30.	Tutorial	Solutions of the problems related to topics covered various examples of mutations	Discussion	BY 1502.2 BY 1502.6	Assignment ETE
31.	Mutation breeding	Evaluate the role of mutations in plant breeding	Lecture	BY 1502.6	Quiz ETE
32.	polyploidy breeding	Critical analysis of polyploidy in plant improvement	Lecture	BY 1502.6	Test/Quiz
33.	Tutorial	Discussion about the effects of mutation in plant breeding	Discussion	BY 1502.6	Assignment ETE
34.	Development of natural polyploidy bread wheat	Develop polyploidy bread wheat plant	Lecture	BY 1502.6	ETE
35.	Molecular markers RFLP, RAPD, Complarison and Advantages	Testing the genetic defect of the plant if any	Lecture	BY 1502.6 BY 1502.7	Assignment/Test ETE
36.	Tutorial	Genetic diversity testing by marker system	Lecture	BY 1502.6 BY 1502.7	Test/Quiz
Lab	To perform emasculation.	To optimize methodology for	Lab Sessions		Experimental results in
Sessions	To identify the different centres of	emasculation, time, bagging, tagging etc.			24 lab sessions
	origin of crop plants on the world map	To optimize parameters for hexaploid			End Term Practical
	To develop polyploidy wheat	wheat development			Examination
	demonstration by bar diagram				

I. Course Articulation Matrix: (Mapping of COs with POs)

		CORRELATION WITH PROGRAM								CORRELATION WITH PROGRAM SPECIFIC		
СО	STATEMENT		OUTCOMES									
	STATEMENT							OUTCOM	ES			
		PO	PO	PO	PO	PO	PO	PO 7	PSO	PSO 2	PSO 3	
		1	2	3	4	5	6		1			
[BY 1502.1].	Understand the scope of plant breeding and developmental	1							2			
	concepts of gene pool and primary origin of the important											
	crops.											
[BY 1502.2].	Discuss the importance of mass selection, hybridization and						1					
	pure line selection for development of improved crop											
[BY 1502.3].	Demonstrate the process of hybrid vigour and inbreeding depression and its practical application in crop improvement programs.				1							
[BY 1502.4].	List the renowned plant breeders of India and their work in the field of plant breeding.		1									
[BY 1502.5].	Apply the process of genotyping and phenotyping using Hardy-Weinberg's equilibrium in agri-crops							1			2	
[BY 1502.6].	Describe mode of pollination, fertilization, and reproduction affects the ability to manipulate genetic variation and develop new varieties which will generate employability						1					
[BY 1502.7].	Investigate the pattern of heredity using the laws of population genetics in the field grown crops for better production.	1								1	2	

I- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation



School of Basic Sciences

Department of Chemistry Course Hand-out

Organic Spectroscopy CY 1613 | 4 Credits | 3 1 0 4

Session: Jan 18 – May 18 | Faculty: Dr Lalita Ledwani | Class: Core subject, BSc (Hons, VI semester)

A. Introduction: This course is offered by Department of Chemistry as a core subject. This course introduces the students to basic fundamentals and topics relevant to the field of organic chemistry. This course offers in depth knowledge of organic spectroscopy for identification of structure of organic compounds.

B. Course Outcomes: At the end of the course, students will be able to

[1613.1] Understand the characteristics of electromagnetic radiations and its interaction with matter; energy and wavelength calculations

[1613.2] Interpret the electronic transitions, experimental and theoretical calculation of wavelength of maximum in UV-Visible Spectroscopy, Fluorescence and Phosphorescence.

[1613.3] Apply the principle of IR spectroscopy, theory of molecular vibrations, scanning of infra-red spectrum, functional and finger print region, spectral features of some classes organic compounds.

[1613.4] Understand fundamental concepts of NMR & Mass spectroscopy

[1412.5] Acquire the skill to recognize different organic compounds using spectroscopic methods.

C. Program Outcomes and Program Specific Outcomes

- [PO.1]. Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.
- [PO.2]. Effective Communication: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.
- [PO.3]. Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.
- [PO.4]. Effective Citizenship: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.
- [PO.5]. Ethics: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.
- [PO.6]. Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.

[PO.7]. Environment and Sustainability: Understand the issues of environmental contexts and sustainable development. Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes.

- [PSO.1]. Recognize and apply the fundamental concepts of chemistry and their applications.
- [PSO.2]. Employ critical thinking and scientific inquiry in the interpretation of theoretical knowledge at a level suitable to succeed at an entry-level position in chemical industry or a post graduate chemistry program.
- [PSO.3]. Understand the applications of chemical sciences in the areas of organic synthesis, synthesis of materials, corrosion inhibition, environment sustainability etc.

D. Assessment Plan:

Criteria	Description	Maximum Marks						
	Sessional Exam I (Closed Book)	20						
Internal Assessment	Sessional Exam II (Closed Book)	20						
(Summative)	Assignments , Activity feedbacks	10						
	(Accumulated and Averaged)							
End Term Exam	End Term Exam (Closed Book)	50						
(Summative)								
	Total	100						
Attendance	A minimum of 75% Attendance is require	red to be maintained by a student to be						
(Formative)	qualified for taking up the End Semester examination. The allowance of 25%							
	includes all types of leaves including medi	cal leaves.						
Make up Assignments	Students who misses a class will have to	report to the teacher about the absence.						
(Formative)	A makeup assignment on the topic taught	on the day of absence will be given which						
	has to be submitted within a week from t	he date of absence. No extensions will be						
	given on this. The attendance for that p	particular day of absence will be marked						
	blank, so that the student is not accour	ited for absence. These assignments are						
	limited to a maximum of 5 throughout th	e entire semester.						
Homework/ Home Assignment/	There are situations where a student may	have to work in home, especially before						
Activity Assignment	a flipped classroom. Although these work	is are not graded with marks. However, a						
(Formative)	student is expected to participate and per	form these assignments with full zeal since						
	the activity/ flipped classroom participatio	n by a student will be assessed and marks						
	will be awarded.							

E. SYLLABUS

CY1613

Organic Spectroscopy

[3 1 0 4]

Electromagnetic Spectrum & Absorption Spectroscopy: Ultraviolet (UV) absorption spectroscopy–absorption laws (Beer-Lambert law), chromophore and auxochrome, bathochromic, hypsochromic, hyperchromic and hypochromic shifts, UV spectra of conjugated enes and enones. **Infrared (IR) absorption spectroscopy** – molecular vibrations, Hooke's law, selection rules, intensity and position of IR bands, measurement of IR spectrum, fingerprint region, characteristic absorptions of various functional groups and interpretation of IR spectra of simple organic compounds; **NMR Spectroscopy:** Nuclear magnetic resonance (NMR) spectroscopy. Proton magnetic resonance, 1 H (1H NMR) spectroscopy, nuclear shielding and deshielding, chemical shift and molecular structure, spin-spin splitting and coupling constants, areas of signals, interpretation of 1H NMR spectra of simple organic molecules such as ethyl bromide, ethanol, acetaldehyde, 1,1,2-tribromoethane, ethyl acetate, toluene and acetophenone basics of ¹³C NMR; **Mass Spectroscopy:** Introduction, instrumentation, Methods of ionization, separation. Fragmentation, McLafferty rearrangement, Problems pertaining to the structure elucidation of simple organic compounds using UV, IR and 1H NMR spectroscopic techniques.

Text Books:

- 1. W. Kemp, Organic Spectroscopy, Palgrave Macmillan, 1991.
- 2. R.M. Silverstein, F.X. Webster, D. Kiemle, *Spectrometric Identification of Organic Compounds*, John Wiley & Sons, 2005.
- 3. D.L. Pavia, G.M. Lampman, G.S. Kriz, J.A. Vyvyan, Introduction to Spectroscopy, Cengage Learning, 2008.

F. Lecture Plan:

LEC NO	TOPICS
1	Introduction and Course Hand-out briefing
2,3	Electromagnetic spectrum & absorption spectroscopy, principle of Ultraviolet (UV)
	absorption spectroscopy
3	The adsorption law (Beer-Lambert law), Measurement of absorption intensity
4,5	The theory of electronic spectroscopy, types of electronic transitions
67	The share and severe the share time and Intensity shifts both share is
0,7	hypsochromic, hyperchromic and hypochromic shifts
7,8	Woodward-fieser rules for calculating absorption maximum
9,10	UV spectra of conjugated enes and enones.
11,12	Applications of UV-Visble Spectroscopy
13,14,15	Problem Solving
16	Infrared (IR) absorption spectroscopy – Basic Principle
17,18,19	Molecular vibrations, vibrational frequency, Hooke's law,
19,20,21	Selection rules, intensity and position of IR bands, measurement of IR spectrum
22,23	Fingerprint region, functional group region
24	Instrumentation, measurement of IR spectrum
25,26	Factors influencing vibrational frequencies
27	Selection Rules
28,29	Scanning of infra-red spectrum
30,31	Characteristic absorptions of various functional groups and interpretation of IR spectra
	of simple organic compounds
32,33	Applications of IR Spectroscopy
34,35,36	Problem Solving
37,38	NMR Spectroscopy: Nuclear magnetic resonance (NMR) spectroscopy-theory and
	Principle, Proton magnetic resonance, 1 H (1H NMR) spectroscopy
39,40	Nuclear shielding and deshielding, chemical shift and molecular structure,
41, 42	Peak area and proton counting, splitting of signals
43,44,45	Spin-spin splitting and coupling constants areas of signals, Instrumentation

46	Interpretation of 1H NMR spectra of simple organic molecules, ¹³ C NMR spectroscopy
47	Application of NMR spectroscopy
48	Problem Solving
49	Mass Spectroscopy: Introduction, Basic principle and theory
50	Instrumentation
51,52	Methods of ionization, Fragmentation, McLafferty rearrangement
53	Important features of mass spectra of hydrocarbons
54-56	Problems pertaining to the structure elucidation of simple organic compounds using UV,
	IR and 1H NMR spectroscopic techniques. Base catalyzed ring opening of epoxides
57	Conclusion and Course Summarization

G. Course Articulation Matrix: (Mapping of COs with POs)

			CORRELATION WITH PROGRAM OUTCOMES							CORRELATION WITH PROGRAM			
СО	STATEMENT									SPECIFIC OUTCOMES			
	STATEMENT	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3		
CY1213.1	Understand the synthesis and chemical reactivity of various hydrocarbon including alkenes, cycloalkenes, dienes and alkynes.	2	1				2	2	2	3	2		
CY1213.2	Complete understanding the concept of aromaticity based on Huckel rule and frost cycle, also able to explain Kekule's structures and MOT for benzene.	3	1				1	1	2	2	1		
CY1213.3	Recognize to write the mechanism of electrophilic aromatic substitution reactions and effect of activating and deactivating group on benzene ring.	3	1				1	2	3	1	3		
CY1213.4	Detailed study of various functional group attached to the aliphatic and aromatic system such alkyl and aryl halides, alcohol and phenol.	2	1				1	1	2	1	3		
CY1213.5	To explain the synthesis and reactivity of ether and cyclic ether (epoxides).	3	1				1	1	1	1	3		

I- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

со	STATEMENT		A	ATTAINMENT OF PROGRAM SPECIFIC OUTCOMES							
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3
CY1213.1	Understand the synthesis and chemical reactivity of various hydrocarbon including alkenes, cycloalkenes, dienes and alkynes.	1.00	0.33				0.67	0.67	1.00	1.00	1.00
CY1213.2	Complete understanding the concept of aromaticity based on Huckel rule and frost cycle, also able to explain Kekule's structures and MOT for benzene.	1.00	0.33				0.67	0.67	1.00	1.00	1.00
CY1213.3	Recognize to write the mechanism of electrophilic aromatic substitution reactions and effect of activating and deactivating group on benzene ring.	1.00	0.33				0.67	0.67	1.00	1.00	1.00
CY1213.4	Detailed study of various functional group attached to the aliphatic and aromatic system such alkyl and aryl halides, alcohol and phenol.	0.00	0.00				0.00	0.00	0.00	0.00	0.00
CY1213.5	To explain the synthesis and reactivity of ether and cyclic ether (epoxides).	2.00	0.67	0.00	0.00	0.00	1.33	1.33	2.00	2.00	2.00

0-No Attainment; I- Low Attainment; 2- Moderate Attainment; 3- Substantial Attainment



School of Basic Sciences

Department of Chemistry Course Hand-out

Organometallic Compounds and Industrial Chemistry | CY1615 | 3 Credits | 2103

Session: Jan. 18 - May 18 | Faculty: Dr. Sriparna Ray | Class: B.Sc. (Chem. Hons.) VI Semester

A. Introduction: This course is offered by Dept. of Chemistry as a core course, targeting students who wish to pursue research & development in industries or higher studies in the field of Inorganic Chemistry. It offers in depth knowledge about organometallic compounds, including main group and transition metals, and various chemical industries. Various chemical industries like Coal and Petroleum based industries, Sugar and Cellulose industries as well as Paints industry are covered. Water and its treatment is also discussed in details in this course.

B. Course Outcomes: At the end of the course, students will be able to

[1615.1] Obtain the basic knowledge of organometallic compounds, including metal-alkyl, metal-carbonyl and metal-olefin compounds

[1615.2] Interpret the structure and bonding involved in metal-hydrogen, carbonyl halides, Metal nitrosyl, nitrosyl carbonyls compounds, as well as dinitrogen, dioxygen and phosphine complexes

[1615.3] Understand the synthesis, structure and bonding aspects of alkyl and aryl complexes, alkylidene complexes and alkylidyne complexes of transition metals

[1615.4] Acquire a proper understanding of the processes involved in water purification

[1615.5] Gain an understanding of the various chemical industrial processes involved in coal and petroleum, sugar, cellulose, rubber and plastics and paints industries so as to increase their employability skills in chemical industries

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

- [PO.1]. Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives
- [PO.2]. Effective Communication: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, andmake meaning of the world by connecting people, ideas, books, media and technology
- [PO.3]. Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.
- [PO.4]. Effective Citizenship: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.
- [PO.5]. Ethics: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.
- [PO.6]. . Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.
- [PO.7]. Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes.

[PSO.1]. Recognize and apply the fundamental concepts of chemistry and their applications.

[PSO.2]. Employ critical thinking and scientific inquiry in the interpretation of theoretical knowledge at a level suitable to succeed at an entry-level position in chemical industry or a post graduate chemistry program.

[PSO.3]. Understand the applications of chemical sciences in the areas of organic synthesis, synthesis of materials, corrosion inhibition, environment sustainability etc. Apply these principles both in simple exercises and in more complex problems of Chemistry

D. Assessment Plan:

Criteria	Description	Maximum Marks							
	Sessional Exam I	20							
Internal Assessment	Sessional Exam II	20							
(Summative)	In class Quizzes and Assignments , Activity feedbacks (Accumulated and Averaged)	10							
End Term Exam	End Term Exam	50							
(Summative)									
	Total	100							
Attendance	A minimum of 75% Attendance is require	red to be maintained by a student to be							
(Formative)	qualified for taking up the End Semest includes all types of leaves including medi	ter examination. The allowance of 25% ical leaves.							
Make up Assignments	Students who misses a class will have to	report to the teacher about the absence.							
(Formative)	A makeup assignment on the topic taught on the day of absence will be given which has to be submitted within a week from the date of absence. No extensions will be given on this. The attendance for that particular day of absence will be marked blank, so that the student is not accounted for absence. These assignments are limited to a maximum of 5 throughout the entire semester.								
Homework/ Home Assignment/	There are situations where a student may	y have to work in home, especially before							
(Formative)	student is expected to participate and per the activity/ flipped classroom participatic will be awarded.	a flipped classroom. Although these works are not graded with marks. However, a student is expected to participate and perform these assignments with full zeal since the activity/ flipped classroom participation by a student will be assessed and marks will be awarded.							

E. SYLLABUS

Organometallics: Definition and classification of organometallic compounds, EAN rule. Organometallic compounds of Mg and Li–Use in synthesis of organic compounds, preparation of Grignard reagent and organo lithium compound, importance of organometallic chemistry in modern times, definition and terminologies, preparation of metal carbonyls, binary carbonyls, mixed metal polynuclear carbonyls, metal-olefin complexes: Zeises salt, Ferrocene, Hapticity (η) of organometallic ligands, Simple examples of fluxional molecules, Coordinative unsaturation, and homogeneous catalysis by organometallic compounds, and polymerization of alkenes (Ziegler-Natta catalysis); Bonding and Structure: Molecular hydrogen compounds, metal-hydrogen interactions with C-H groups, carbonyl halides, Metal nitrosyl compounds, nitrosyl carbonyls. Dinitrogen and dioxygen complexes, tertiary phosphines as ligand; Organotransition metal Chemistry: Synthesis, structure and bonding aspects of complexes of two, three, four and six electrons cyclic and acyclic ligands. Alkyl and aryls of Transition metals, transition metal-carbon multiple bonds; alkylidene complexes and alkylidyne complexes. Water and its treatment: Sources of water, impurities in water, hardness of water and hardeness removal; Coal Chemicals: Ultimate and proximate analysis of coal and their significance, coking of coal by high temperature (By-product coke-oven) and low temperature process. Plastics and Rubber: Classification of plastics, manufacture, properties and uses of nylon 6 and nylon 6 6. manufacture of natural rubber from latex, introduction about synthetic rubbers; Sugar Industry: Extraction of juice from sugar cane. Manufacture and refining of sugar. Uses of molasses and bagasse. Cellulose Industry: Study of raw materials for the manufacture of paper. Manufacture of wood pulp by different (soda, sulphite and sulphate) processes. Multistage bleaching of wood pulp. Conversion of pulp into thin paper by Fourdrinier machine. Petroleum Industry: Composition and classification of crude

petroleum. Refining of petroleum and brief introduction regarding each refining product. Thermal and catalytic cracking of petroleum products. Significance of octane number and cetane number. **Paints Industry:** Introduction, classification of paints, manufacture of paints, requirements of a good paint.

F. TEXT BOOKS

- 1. B.D. Gupta and A. J. Elias, *Basic Organometallic Chemistry*, University Press, 2010.
- 2. R.C. Mehrotra and A. Singh, Organometallic chemistry: A unified approach, Wiley, New York, 1991
- 3. J. A. Kent, *Riegel's Handbook of Industrial Chemistry*, CBS, 1997.

G. REFERENCE BOOKS

- 1. F.A. Cotton and G. Wilkinson, Advanced Inorganic Chemistry, John Wiley.
- 2. C. Housecroft and A, G. Sharpe, *Inorganic Chemistry*, Pearson India, 2012.

H. Lecture Plan:

LEC NO	TOPICS
1 - 2	Organometallics: Definition and classification of organometallic compounds, EAN rule.
3 - 4	Organometallic compounds of Mg and Li–Use in synthesis of organic compounds,
	preparation of Grignard reagent and organo lithium compound
5	Importance of organometallic chemistry in modern times. Definition and terminologies
6 - 7	Preparation of metal carbonyls, binary carbonyls, mixed metal polynuclear carbonyls,
8 - 9	metal-olefin complexes: Zeises salt, Ferrocene, Hapticity (η) of organometallic ligands, Simple examples of fluxional molecules,
10	Coordinative unsaturation, and homogeneous catalysis by organometallic compounds, and polymerization of alkenes (Ziegler-Natta catalysis);
11	Revision on Organometallics involving CO, olefins, etc.
12	Bonding and Structure: Molecular hydrogen compounds, metal-hydrogen interactions with C-H groups,
13	carbonyl halides, Metal nitrosyl compounds, nitrosyl carbonyls.
14	Dinitrogen and dioxygen complexes, tertiary phosphines as ligand;
15	Revision on Structure and Bonding
15 - 16	Organotransition metal Chemistry: Synthesis, structure and bonding aspects of complexes of two, three, four and six electrons cyclic and acyclic ligands.
17 – 18	Alkyl and aryls of Transition metals, transition metal-carbon multiple bonds; alkylidene complexes and alkylidyne complexes.
19	Revision on Organotransition metal complexes
20 - 21	Water and its treatment: Sources of water, impurities in water, hardness of water and hardeness removal;
22 - 23	Coal Chemicals: Ultimate and proximate analysis of coal and their significance, coking
	of coal by high temperature (By-product coke-oven) and low temperature process.
24	Revision on Water Treatment and Coal industry

25 - 26	Plastics and Rubber:Classification of plastics, manufacture, properties and uses of nylon 6 and nylon 6 6. manufacture of natural rubber from latex, introduction about synthetic rubbers;
27 – 28	Sugar Industry: Extraction of juice from sugar cane. Manufacture and refining of sugar. Uses of molasses and bagasse.
29	Revision on Plastics and Sugar industry
30 - 31	Cellulose Industry:Study of raw materials for the manufacture of paper. Manufacture of wood pulp by different (soda, sulphite and sulphate) processes.
32 - 34	Multistage bleaching of wood pulp. Conversion of pulp into thin paper by Fourdrinier machine.
35	Petroleum Industry: Composition and classification of crude petroleum.
36	Refining of petroleum and brief introduction regarding each refining product.
37-38	Thermal and catalytic cracking of petroleum products. Significance of octane number and cetane number.
39 - 40	Paints Industry: Introduction, classification of paints, manufacture of paints, requirements of a good paint.
41 - 42	Revision

со	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES							CORRELATION WITH PROGRAM SPECIFIC OUTCOMES			
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3	
[CY1615.1]	Obtain the basic knowledge of organometallic compounds, including metal-alkyl, metal-carbonyl and metal-olefin compounds	2	1					3	3			
[CY1615.2]	Interpret the structure and bonding involved in metal- hydrogen, carbonyl halides, Metal nitrosyl, nitrosyl carbonyls compounds, as well as dinitrogen, dioxygen and phosphine complexes	3					2	1	2	3		
[CY1615.3]	Understand the synthesis, structure and bonding aspects of alkyl and aryl complexes, alkylidene complexes and alkylidyne complexes of transition metals	2							1		1	
[CY1615.4]	Acquire a proper understanding of the processes involved in water purification			3		1				2	3	
[CY1615.5]	Gain an understanding of the various chemical industrial processes involved in coal and petroleum, sugar, cellulose, rubber and plastics and paints industries						3	2		2	3	

I- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

J. Course Outcome Attainment Level Matrix:

со	STATEMENT		ATTAIN	MENT O THRESH	ATTAINMENT OF PROGRAM SPECIFIC OUTCOMES						
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3
[CY1615.1]	Obtain the basic knowledge of organometallic compounds, including metal-alkyl, metal-carbonyl and metal- olefin compounds	1.00	0.33					1.00	1.00		
[CY1615.2]	Interpret the structure and bonding involved in metal-hydrogen, carbonyl halides, Metal nitrosyl, nitrosyl carbonyls compounds, as well as dinitrogen, dioxygen and phosphine complexes	1.00					1.00	1.00	1.00	1.00	
[CY1615.3]	Understand the synthesis, structure and bonding aspects of alkyl and aryl complexes, alkylidene complexes and alkylidyne complexes of transition metals	3.00							3.00		3.00
[CY1615.4]	Acquire a proper understanding of the processes involved in water purification			2.00		0.67				2.00	2.00
[CY1615.5]	Gain an understanding of the various chemical industrial processes involved in coal and petroleum, sugar, cellulose, rubber and plastics and paints industries		0.67	2.00	0.00	0.67	2.00	2.00	2.00	2.00	2.00

0-No Attainment; 1- Low Attainment; 2- Moderate Attainment; 3- Substantial Attainment



School of Basic Sciences

Department of Mathematics Course Hand-out

Complex analysis | MA1611| 4 Credits | 3104

Session: Jan 18 - May 18 | Faculty: Dr. Virendra Singh Chouhan

A. Introduction: This course is offered by Dept. of Mathematics as a core subject, targeting students who wish to pursue research or higher studies in the field of Complex Analysis and want to compare with Real Analysis.

Students are expected to have background knowledge on complex numbers and integration for a better learning.

Course Objectives: At the end of the course, students will be able to

- **[1611.1]** Enhance the limit, continuity, differentiability and analyticity of the complex valued functions.
- [1611.2] Find some special type of complex transforms.
- **[1611.3]** Improve the skill to find the complex integrations and its applications.
- [1611.4] Apply their skill to find some particular type of theorems used for complex valued function.
- [1611.5] Develop the skill to find out singularity and radius of convergence.

B. Program Outcomes and Program Specific Outcomes

PO1.**Critical Thinking**: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.

PO2.**Effective Communication**: Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.

PO3. **Social Interaction**: Elicit views of others, mediate disagreements and help reach conclusions in group settings.

PO4. **Effective Citizenship**: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.

PO5. **Ethics**: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.

PO6. Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.

PO7. **Self-directed and Life-long Learning**: Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes

C. Assessment Rubrics:

Criteria	Description	Maximum Marks
	Sessional Exam I (Close Book)	20
Internal Assessment	Sessional Exam II (Close Book)	20
(Summative)	In class Quizzes and Assignments ,	10
	Activity feedbacks (Accumulated and	
	Averaged)	
End Term Exam	End Term Exam (Close Book)	50
(Summative)		
	Total	100
Attendance	A minimum of 75% Attendance is requir	red to be maintained by a student to be
(Formative)	qualified for taking up the End Semest	er examination. The allowance of 25%
	includes all types of leaves including medi	cal leaves.
Make up Assignments	Students who misses a class will have to	report to the teacher about the absence.
(Formative)	A makeup assignment on the topic taught	on the day of absence will be given which
	has to be submitted within a week from t	he date of absence. No extensions will be
	given on this. The attendance for that p	particular day of absence will be marked
	blank, so that the student is not accour	ted for absence. These assignments are
	limited to a maximum of 5 throughout th	e entire semester.
Homework/ Home Assignment/	There are situations where a student may	have to work in home, especially before
Activity Assignment	a flipped classroom. Although these work	is are not graded with marks. However, a
(Formative)	student is expected to participate and per	form these assignments with full zeal since
	the activity/ flipped classroom participatio will be awarded.	n by a student will be assessed and marks

D. Syllabus

Complex valued function, Limits, Continuity, Differentiability, Complex plane, Connected and compact sets, Statement of Jordan curve theorem, Extended complex plane, Stereographic projection. **Analytic functions**: CR equations (Cartesian and polar form), Harmonic functions, Construction of an analytic function. **Conformal Mappings. Bilinear Transformations and Its Properties. Power Series**: Absolute convergence, Cauchy Hadamard theorem, Radius of convergence, Analyticity of sum function of a power series. **Complex Integration**: Complex line integral, Cauchy's integral theorem, Indefinite integral, Fundamental theorem of integral calculus for complex functions, Cauchy's integral formula, Analyticity of the derivative of analytic function, Liouville's theorem, Poisson's integral formula, Morera's theorem, Taylor's and Laurent's series, Maximum modulus principle. **Singularities**: Branch points, Kinds of singularities, monomorphic functions, Entire functions, Riemann's theorem, Cauchy-Weierstrass theorem.

E. Text Books

- 1. R.V. Churchill, J. W. Brown, Complex Variables and Applications, McGraw Hill, 2000.
- 2. Shanti Narayan, P. K. Mittal, Complex Variables, S. Chand & Co., 2014.
- 3. S. Ponnusamy, Foundations of Complex Analysis, Narosa Pub. House, 2008.

F. Reference Books

- 1. J. B. Conway, Functions of One Complex Variable, Springer Int. St. Ed., Narosa Publishing House, 2000.
- 2. A. R. Vashishtha, Complex Analysis, Krishna Prakashan, 2010.
- 3. G. N. Purohit, S. P. Goyal, Complex Analysis, Jaipur Pub. House, 2005.
- 4. Shantinarayan, Complex Variables, S. Chand & Co., New Delhi, 2010.

G. Lecture Plan:

LEC NO.	TOPICS
I	Introduction of complex valued Functions
2	Limit, Continuity and differentiability of complex functions
3	Definition of Complex plane, Connected and compact sets
4	Jordan curve theorem, Extended complex plane
5	Stereographic projection
6	Definition of Analytic functions , necessary and sufficient condition for analytic functions
7,8	CR equations (Cartesian and polar form)
9,10	Definition of Harmonic functions and related Questions
	Constructions of analytic functions by Milne-Thomson Method
12	Introduction of Conformal Mapping
13	Elementary Mapping
14,15	Bilinear Transformations and Its Properties
16,17	Power Series: Definition, Abels Theorem, Cauchy Hadamard Theorem
18	Circle and Radius of convergence of a power series
19	Analyticity of sum function of a power series
20	Complex Integration: Introduction
21	Complex line integral, Indefinite integral
22,23	Illustrative examples on Complex integral
24	Cauchy's integral theorem, simple and multi connected region
25	Fundamental theorem of integral calculus for complex functions
26	Cauchy's integral formula(With Proof)
27,28	Illustrative examples on Cauchy's integral formula and Theorem
29	Analyticity of the derivative of analytic function
30,31	Illustrative examples on derivative of analytic functions
32	Liouville's theorem (with proof)
33	Poisson's integral formula (with proof)
34	Morera's theorem (with proof)
35	Maximum modulus principle (with proof)
36, 37	Singularities: Introduction, kind of singularities
38	Illustrative examples on Singularities
39	Definition and introduction Monomorphic functions, Entire functions
40	Riemann's theorem (with proof)
41	Cauchy-Weierstrass theorem (with proof)
42,43	Illustrative examples

H. Course Articulation Matrix: (Mapping of COs with POs)

со	STATEMENT		CORRELATION WITH PROGRAM OUTCOMES									CORRELATION WITH PROGRAM SPECIFIC OUTCOMES				
		PO 1	PO 2	PO 3	РО 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
MA 1611.1	Enhance the limit, continuity, differentiability and analyticity of the complex valued functions.	2		1		2		3								
MA 1611.2	Find some special type of complex transforms.	3			3			2								
MA 1611.3	Improve the skill to find the complex integrations and its applications.	1		3		2										
MA 1611.4	Apply their skill to find some particular type of theorems used for complex valued function.		2		3		2									
MA 1611.5	Develop the skill to find out singularity and radius of convergence.		2			1	3									

I- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

I. Course Outcome Attainment Level Matrix:

со	STATEMENT		ATTAINMENT OF PROGRAM OUTCOMES THRESHOLD VALUE: 40%											ATTAINMENT OF PROGRAM SPECIFIC OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
MA 1611.1	Course Outcome statement	3							1							
MA 1611.2	Course Outcome statement		2	2								2				
MA 1611.3	Course Outcome statement				2	2										
MA 1611.4	Course Outcome statement						2		2	3						
MA 1611.5	Course Outcome statement			1						1	1					

0-No Attainment; I- Low Attainment; 2- Moderate Attainment; 3- Substantial Attainment



DEPARTMENT OF Mechanical ENGINEERING Department of Mathematics and Statistics Course Hand-out

Algebra | MA 1613 | 4 Credits

Session: Jan 18-May 18 | Faculty: Dr. Ram Naresh Saraswat

- A. Introduction: This course is offered by Dept. of Mathematics as core subject, targeting students who wish to pursue research & development in industries or higher studies in field of Engineering. Offers in depth knowledge matrix, sequence and series, differential calculus, integral calculus and differential calculus. Students are expected to have background knowledge on integration and differentiation for a better learning.
- **B. Course Outcomes:** At the end of the course, students will be able to
 - [1613.1] analyse the problems of groups and their properties.
 - [1613.2] Understand basic concepts of cyclic group, normal sub group,
 - [1613.3] Uunderstanding of homeomorphism of groups.
 - [1613.4] Able to find kernel and image of a given homeomorphism, subring and field.
 - [1613.5] Produce examples of concept of algebra and its application to develop mathematical and analytic skills.

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

- [PO.1]. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
- **[PO.2]. Problem analysis**: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences
- **[PO.3]. Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes_that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations
- **[PO.4]. Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions
- **[PO.5]. Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations
- **[PO.6]. The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice
- [PO.7]. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development

- [PO.8]. Ethics: Apply ethical principles and commit to professional ethics_and responsibilities and norms of the engineering practices
- [PO.9]. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings
- **[PO.10].** Communication: Communicate effectively_on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions
- **[PO.11]. Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments
- **[PO.12].** Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

PROGRAM SPECIFIC OUTCOMES

- **[PSO.1].** Autotronics and Electric Vehicle Technology: Apply knowledge of electrical and electronics engineering for providing automobile engineering solutions
- **[PSO.2].** Alignment to Super Qualification packs of ASDC: Demonstrate knowledge and performance criteria as defined by ASDC super qualification packs for R&D or Quality or Service Engineering
- [PSO.3]. Application of Lean Six Sigma Methodology: Demonstrate through an internship project, the knowledge and understanding of lean six sigma methodology based on Define, Measure, analyse, improve/develop and control/validate phases (DMAIC/ DMADV).

Criteria	Description	Maximum Marks						
	Sessional Exam I (Close Book)	20						
Internal Assessment	Sessional Exam II (Close Book)	20						
(Summative)	In class Quizzes and Assignments,	10						
	Activity feedbacks (Accumulated							
	and Averaged)							
End Term Exam	End Term Exam (Close Book)	50						
(Summative)								
	Total	100						
Attendance	A minimum of 75% Attendance is req	uired to be maintained by a student to						
(Formative)	be qualified for taking up the End Semester examination. The allowance							
	25% includes all types of leaves include	ding medical leaves.						
Make up Assignments	Students who misses a class will ha	ve to report to the teacher about the						
(Formative)	absence. A makeup assignment on the	topic taught on the day of absence will						
	be given which has to be submitted w	ithin a week from the date of absence.						
	No extensions will be given on this. T	he attendance for that particular day of						
	absence will be marked blank, so t	hat the student is not accounted for						
	absence. These assignments are limited	ed to a maximum of 5 throughout the						
	entire semester.							
Homework/ Home Assignment/	There are situations where a student r	may have to work in home, especially						
Activity Assignment	before a flipped classroom. Although t	hese works are not graded with marks.						
(Formative)	However, a student is expected to part	icipate and perform these assignments						
	with full zeal since the activity/ flippe	d classroom participation by a student						
	will be assessed and marks will be aw	arded.						

D. Assessment Plan:

E. SYLLABUS

Group: Algebraic structure, Definition of a group with examples and simple properties, Subgroups, Cyclic groups, Permutation groups, Even and odd permutations, The alternating group A_n, Cayley theorem, Coset decomposition, Lagrange's theorem and its consequences, Fermat's and Euler's theorems, Normal subgroups, Quotient groups, Homomorphism and Isomorphism, The fundamental theorem of homomorphism. **Rings:** Definition and properties of ring, integral domain and field.

Text Books:

- 1. Khanna and Bhambri, A course in Abstract Algebra, Vikas Publication House, 2015.
- 2. M. D. Raisinghania, Modern Algebra, S. Chand & Co., 2013.
- 3. A. R. Vashishtha, Modern Algebra, Krishna Prakashan, 2008.

Reference Books:

- 1. I. N. Herstein, Topics in Algebra, Wiley Eastern Ltd., New Delhi, 2006.
- 2. N. S. Gopalkrishnan, University Algebra, New Age Int. Pub., 2008.
- 3. S. M. Lane, G. Birkhoff, Algebra, AMS Chelsea Pub., 1988.

Lecture Plan:

Description of the Topics	Required Lectures	Cumulated Lectures
Groups		
Introduction the set theory	1	1
Algebraic structure and related problems	3	4
semi group, monoid and related problems	2	6
Group and its properties	1	7
Subgroups		
Introduction of Cyclic groups	2	9
Generators of the cyclic group	1	10
Commutators	2	12
Permutation groups		
Introduction of Permutation groups	1	13
Even and odd permutations Even and odd permutations	2	15
The alternating group A _n	2	17
Cayley theorem	2	19
Normal subgroups	2	21
Quotient groups	2	23
Homomorphism on groups	2	25
Isomorphism on groups	2	27
The fundamental theorem of homomorphism	2	29
Rings		
Definition and properties of ring	1	30
Sum of two rings	2	32
Characteristics of rings	2	34
Product of ring	2	36
Ideals	2	38
Sum of ideals	1	39
More on ideals	2	41
Product of ideals	2	43
Integral domain		
Integral domain	2	45
Euclidean Domain and Factorization domain	2	47
Field	3	50
END SEMESTER EXAMI	NATION	

F. Course Articulation Matrix: (Mapping of COs with POs)

СО	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES										CORRELATION WITH PROGRAM SPECIFIC OUTCOMES				
		PO 1	PO 2	PO 2	PO 4	PO 5	PO 6	PO 7	PO v	PO 0	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
MA16130.1	Analyse the problems of groups and their properties.	2	2	5	7	5	0	/	0	7	2	11	12	1		
MA 1613.2	Understand basic concepts of cyclic group, normal sub group,	2			1										2	
MA 1613.3	Uunderstanding of homeomorphism of groups.	2				1										1
MA 1613.4	Able to find kernel and image of a given homeomorphism, subring and field.	2									1					
MA 1613.5	Produce examples of concept of algebra and its application to develop mathematical and analytic skills .	2		1								1				

1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation

G. Course Outcome Attainment Level Matrix:

СО	STATEMENT		ATTAINMENT OF PROGRAM OUTCOMES THRESHOLD VALUE: 40%											ATTAINMENT OF PROGRAM SPECIFIC OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
MA16130.1	Analyse the problems of groups and their properties.	3							1					1		
MA 1613.2	Understand basic concepts of cyclic group, normal sub group,		2	2								2			2	
MA 1613.3	Uunderstanding of homeomorphism of groups.				2	2										1
MA 1613.4	Able to find kernel and image of a given homeomorphism.						2		2	3						
MA 1613.5	Understand basic concepts of subrings and integral domain			1						1	1					

0-No Attainment; 1- Low Attainment; 2- Moderate Attainment; 3- Substantial Attainment

School of Basic Sciences

Department of Biosciences Course Hand-out



Taxonomy and Embryology of Angiosperms| BY 1601 | 3 Credits | 2 | 0 3

Session: 2018-2019 | Faculty: Dr. Jain Rohit | Class: VI Semester

- A. Introduction: This course is offered by Dept. of Biosciences as a core course in B.Sc. (Hons.) Biotechnology and, as a subsidiary course in B.Sc. (Pass) Biotechnology Programme targeting students who wish to pursue their career in the higher studies or research area of economically important plants and their development. This course introduces the classification, relationships, structure, and function of plants. How the plants are given, a specific nomenclature is the major highlight of the course. Topics include reproduction and development of seed plants, levels of organization, form and function of systems, and a survey of major families. Upon completion, students should be able to demonstrate comprehension of plant form and function, including selected families and economically important genus.
- **B. Course Outcomes**: At the end of the course, students will be able to:
 - **[BY 1601.1].** Understand and list the forms and functions of economically important plant species.
 - **[BY 1601.2].** Apply the rules of International Code for Botanical Nomenclature (ICBN) for scientific nomenclature of plants
 - **[BY 1601.3].** Analyse different changes during plant development from seed germination to zygote formation and development of fruits.
 - [BY 1601.4]. Differentiate among various fruit types based on their structure
 - **[BY 1601.5].** Explain the process of dehiscence and seed dispersal, seed dormancy, seed germination and plant development
 - **[BY 1601.6].** Design the taxonomic keys to describe economically important plants and hence to increase the skills for employability in taxonomy and horticulture

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

- **[PO.I].** Critical Thinking: Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational and personal) from different perspectives.
- **[PO.2]. Effective Communication:** Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.
- **[PO.3].** Social Interaction: Elicit views of others, mediate disagreements and help reach conclusions in group settings.
- **[PO.4].** Effective Citizenship: Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.
- **[PO.5].** Ethics: Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.
- [PO.6]. Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.
- **[PO.7].** Self-directed and Life-long Learning: Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes.
- **[PSO.I.]** To demonstrate competency in factual content and interpretation of the major biological concept areas of cell and molecular biology, genetics, organismal biology, and evolution and ecology.
- **[PSO.2.]** To demonstrate the ability to identify significant biological research questions, develop research protocols, and properly analyze research questions through the use of the scientific method.
- **[PSO.3.]** Enhance analytical and quantitative skills and demonstrate an understanding of basic computational and statistical techniques in the field of Biotechnology

D. Assessment Plan:

Criteria	Description	Maximum Marks

	Mid Term Exam I – IA I	20
Internal Assessment	Mid Term Exam 2 - IA 2	20
(IA)	CWS Assessment IA 3	10
	10 marks of IA 3 are awarded based on the various	
	assignments, class tests, seminar presentation etc.	
End Term Exam (EX)	End Term Exam – EX I	50
	Total	100

NOTE: A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leave

E. SYLLABUS:

Taxonomy: Systems of classification: artificial systems, natural system, phylogenetic system; salient features of the system proposed by Linnaeus, Bentham and Hooker. Binomial nomenclature, ICBN, Botanical gardens and herbaria of India. Study of members of the following families: Brassicaceae, Malvaceae, Papillionaceae, Asteraceae, Asclepiadaceae, Solanaceae, Euphorbiaceae and Poaceae. Embryology: Structure of anthers, microsporogenesis, pollination and its types, pollen germination. Megasporogenesis, ovule development, types of ovules, development and types of embryo sac and double fertilization, endosperm and its types. Embryogenesis: embryo development, polyembryony, Structure of seed in monocotyledons and dicotyledons, Seed dormancy.

F. TEXT BOOKS

- 1. Maheshwari. S.C. An Introduction to Embryology of Angiosperms, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2012.
- 2. Tyagi. Y.D. An Introduction to Taxonomy of Angiosperms, Himalaya Publishing House, New Delhi, 1996

G. REFERENCE BOOKS

- A. Nordemstam, B.E.L., Gazaly, G. and Kassas, M. Plant Systematics for 21st Century, Portland Press Ltd., London, 2000.
- B. Lersten, N.R. Flowering Plant Embryology, Wiley-Blackwell, New Delhi, India, 200

Lecture	Торіс	Session Outcome	Mode of Delivery	Corresponding	Mode of assessing the
	-			co	outcome
Ι.	Taxonomy: Introduction, history and	Discuss the importance of taxonomy	Lecture	-	MTE I
	scope				Test/Quiz
2.	Systems of classifications: Artificial,	Explain merits and demerits of different	Lecture	-	MTE I
	natural and phylogenetic	systems of classification			Test
					ETE
3.	Tutorial	Recall the importance taxonomy and	Discussion	-	Test/Quiz
		classification systems			Assignment
4.	Artificial system: Classification proposed	Understand the basis of artificial classification	Lecture	-	MTE I
	by Linnaeus				Quiz
					ETE
5.	Natural system of classification: Bentham	Explain the natural system of classification	Lecture	-	MTE I
	& Hooker				Test
					ETE
6.	Tutorial	Recall the merits and demerits of artificial and	Discussion/Lecture	-	Quiz
		natural classification			Assignment
7.	Binomial nomenclature and trinomial	Apply the rules for scientific nomenclature of	Lecture	BY 1601.2	MTE I
	nomenclature, ICBN and its regulations	plants			Quiz
					ETE
8.	Botanical gardens and herbariums-	Discuss the importance of herbarium and	Lecture	BY 1601.1	MTEI
	Importance	botanical gardens			Test
			-		ETE
9.	Tutorial	Recall the importance of nomenclature and	Discussion	BY 1601.1	Test
		role of ICBN			Assignment
10.	Descriptive features of flower, floral	Explain the floral characteristics using floral	Lecture	BY 1601.7	MTEI
	formula and floral diagram	formula and diagram			Test
					ETE
11.	Taxonomic keys and literature	Design taxonomic keys for identification of	Lecture	BY 1601.7	MTEI
		unknown plants			Quiz
	—		.		
12.	lutorial	Recall the steps involved in preparation of	Discussion	BY 1601./	lest
		taxonomic keys of floral characteristics			Assignment
13.	Family: Brassicaceae	Identify plants belonging to family Brassicaceae	Lecture	BY 1601.6	MIE2
					Quiz
14.	ramily: Malvaceae	Identity plants belonging to family Malvaceae	Lecture	BI 1601.6	

15.	Tutorial	Recall the characteristic features of Brassicaceae and Malvaceae	Discussion	BY 1601.6	Test/Quiz
16.	Family: Fabaceae Sub family: Papilionaceae	Identify plants belonging to subfamily Papilionaceae	Lecture	BY 1601.6	MTE 2 Test ETE
17.	Sub Family: Cesselpiniaceae, Momosaceae	Identify and classify the plants into Cesselpiniaceae and Momosaceae	Lecture	BY 1601.6	MTE 2 Quiz ETE
18.	Tutorial	Differentiate between characteristic features of subfamilies of Fabaceae	Discussion	BY 1601.6	Quiz Assignment
19.	Family: Asteraceae	Understand the characteristics of Asteraceae	Lecture	BY 1601.6	MTE 2 Test ETE
20.	Family: Asclepidaceae	Identify plants belonging to family Asclepidaceae	Lecture	BY 1601.6	MTE 2 Test ETE
21.	Tutorial	Classify the plants in to Asteraceae and Asclepidaceae families	Discussion	BY 1601.6	Test/Quiz
22.	Family: Solanaceae	Identify the plants belonging to Solanaceae	Lecture	BY 1601.6	MTE 2 ETE
23.	Family: Euphorbiaceae	Identify the plants belonging to Euphorbiaceae	Lecture	BY 1601.6	MTE 2 ETE
24.	Tutorial	Recall the characteristics of Solanaceae and Euphorbiaceae	Discussion	BY 1601.6	Test/Quiz
25.	Family: Poaceae	Identify the plants belonging to Poaceae	Lecture	BY 1601.6	Test/Quiz ETE
26.	Embryology: History and introduction, Structure of anthers, microsporogenesis	Understand the process of pollen formation	Lecture	BY 1601.3	Test ETE
27.	Tutorial	Recall the characteristics of Poaceae and steps involved in microsporogenesis	Discussion	BY 1601.3	Test/Quiz
28.	Pollination: Cross-pollination and its types	Explain the process of cross-pollination	Lecture	BY 1601.3	Test ETE
29.	Self- pollination and its types	Explain different types of self-pollination	Lecture	BY 1601.3	Test ETE
30.	Tutorial	Enlist examples for both self-pollinated and cross-pollinated plants	Discussion	BY 1601.3	Test/Quiz Assignment
31.	Megasporogenesis: Development and types of embryosac	Understand the process of embryosac and differentiate between its different types	Lecture	BY 1601.3	Quiz ETE
32.	Megasporogenesis: Development and Types of ovules and their examples, Fertilization	Classify plants based on their ovule type and enderstand the process of zygote formation	Lecture	BY 1601.3	Test ETE
33.	Tutorial	Recall the process of embryosac development and zygote formation	Discussion	BY 1601.3	Test Quiz

34.	Development of endosperm and its types	Explain the importance of embryosac and	Lecture	BY 1601.3	Quiz
		classify plants based on its different types		BY 1601.4	ETE
35.	Embryogenesis: Embryo development	Explain the process of embryo development	Lecture	BY 1601.3	Test
	and polyembryony				ETE
36.	Seed: structure and types in dicotyledons	Classify plants based on their seed types	Lecture	BY 1601.5	Test
	and monocotyledons				ETE
37.	Tutorial	Recall the process of embryogenesis and	Discussion	BY 1601.3	Test/Quiz
		classify plants based on endosperm and seed		BY 1601.4	
		type		BY 1601.5	
Lab	To identify and classify plants based on	Classify the plants in their surrounding	Lab Sessions	BY 1601.7	Experimental results in 24
Sessions	their floral morphology into different	environment into different families			lab sessions
	families	Prepare herbarium sheets for identification of			End Term Practical
	To collect plant specimens during field	plants			Examination
	visits and prepare herbarium sheets	Identify unknown plant through taxonomic			
	To prepare taxonomic keys for	keys			
	identification of unknown plant species				

		CORRELATION WITH PROGRAM			CORRELATION WITH						
СО	STATEMENT	OUTCOMES PROG				GRAM SPECIFIC					
						OUTCOMES					
		PO	PO	PO	PO	PO	PO	PO 7	PSO	PSO 2	PSO 3
		I	2	3	4	5	6		I		
[BY 1601]. Understand and list the forms and functions of economically								2		
	important plant species.										
[BY 1601	2]. Apply the rules of International Code for Botanical Nomenclature							I			
	(ICBN) for scientific nomenclature of plants										
[BY 1601	J. Analyse different changes during plant development from seed	Ι							I		
	germination to zygote formation and development of fruits.										
[BY 1601	Differentiate among various fruit types based on their structure								I		
[BY 1601	1. Explain the process of dehiscence and seed dispersal, seed dormancy,								I		
	seed germination and plant development										
[BY 1601	Design the taxonomic keys to describe economically important plants				Ι				I		
	and hence to increase the skills for employability in taxonomy and										
	horticulture										
•	· · · · · · · · · · · · · · · · · · ·	Laur Canalatians 2		Mad		C	- 4 ¹ ¹	Cubata			

I- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation



School of Basic Sciences

Department of Biosciences Course Hand-out

Applied Botany| BY 1602 | 3 Credits | 2 | 0 3

Session: 2018-19 | Faculty: Sharma Madan Mohan | Class: VI Semester

- A. Introduction: This course is offered by Dept. of Biosciences as a core course in B.Sc. (pass) Biotechnology, Botany/Bioscience, Chemistry/Psychology and, as a subsidiary course in B.Sc. (Hons) Biotechnology Programme targeting students who wish to pursue their career in the field of Applied Botany. The course includes in depth knowledge of the applied aspects of botany such as horticulture, floriculture, olericulture and plant tissue culture. The students will learn to setup a green house/ net house and also design of a botanical garden for small scale propagation of economically important and ornamental plants. The students need to have basic knowledge of soil sampling, nutrient requirements and culture conditions of plants.
- **B. Course Outcomes:** At the end of the course, students will be able to
 - **[BY 1602.1].** Define common horticultural practices and techniques of plant propagation i.e. seed sowing, pruning & planting
 - [BY 1602.2]. Discuss common vegetative propagation methods such as grafting, cutting and ground layering
 - [BY 1602.3]. Classify the plants based on their various categories of uses like in olericulture, pomology, viticulture, floriculture etc.
 - [BY 1602.4]. Execute growth constraints and natural plant propagation techniques in nature
 - **[BY 1602.5].** Evaluate various environmental factors affect plant growth & development
 - **[BY 1602.6].** Designing of greenhouse/ net house for manipulation of microclimate for optimum growth of plants and develop employability skills

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

- **[PO.1]. Critical Thinking:** Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational and personal) from different perspectives.
- **[PO.2]. Effective Communication:** Speak, read, write and listen clearly in person and through electronic media in English and in one Indian language, and make meaning of the world by connecting people, ideas, books, media and technology.
- **[PO.3]. Social Interaction:** Elicit views of others, mediate disagreements and help reach conclusions in group settings.
- **[PO.4]. Effective Citizenship:** Demonstrate empathetic social concern and equity centred national development, and the ability to act with an informed awareness of issues and participate in civic life through volunteering.
- **[PO.5]. Ethics:** Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.
- [PO.6]. Environment and Sustainability: Understand the issues of environmental contexts and sustainable development.
- **[PO.7]. Self-directed and Life-long Learning:** Acquire the ability to engage in independent and life-long learning in the broadest context socio-technological changes. To demonstrate competency in factual content and interpretation of the major biological concept areas of cell and molecular biology, genetics, organismal biology, and evolution and ecology.
- **[PSO.1.]** To demonstrate competency in factual content and interpretation of the major biological concept areas of cell and molecular biology, genetics, organismal biology, and evolution and ecology.
- **[PSO.2.]** To demonstrate the ability to identify significant biological research questions, develop research protocols, and properly analyze research questions through the use of the scientific method.

[PSO.3.] Enhance analytical and quantitative skills and demonstrate an understanding of basic computational and statistical techniques in the field of Biotechnology

D. Assessment Plan:

Criteria	Description	Maximum Marks		
	Mid Term Exam I – IA I	20		
Internal Assessment	Mid Term Exam 2 - IA 2	20		
(IA)	CWS Assessment IA 3	10		
	10 marks of IA 3 are awarded based on the various			
	assignments, class tests, seminar presentation etc.			
End Term Exam (EX)	End Term Exam – EX I	50		
	Total	100		

NOTE: A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.

E. SYLLABUS

Horticulture: Fundamentals, techniques of plant propagation, a brief account of pomology, olericulture, floriculture and ornamental horticulture, viticulture, applications of plant tissue culture in horticulture. Development of garden and nursery: fundamentals of landscape design, principles and styles of landscape design, propagation and conservation of plants. Management of gardens. Industrial Botany: Organic farming, biofuels and biodiesel, applications of plants in cosmetic industry, aroma therapy, pharmaceutical industry, phytoremediation. Centre of origin of crop plants (wheat, rice and maize).

F. TEXT BOOKS

- 1. Chadha, K. L. Handbook of Horticulture, ICAR Publication, New Delhi, 2008.
- 2. Sharma, P.D. Ecology and Environment, Rastogi Publication, New Delhi, 2012.
- 3. Kocchar, S.L.. Economic Botany in Tropics, McMillan India Ltd., 2nd edition, New Delhi, 2010.

G. REFERENCE BOOKS

- I Hartman, H. T. and Kester, D. E.. Plant propagation principles and practices, Prenice Hall of India, New Delhi, 1989.
- 2. Odum, E.P. Fundamentals of Ecology, Saunders, Philadelphia, New York, 1996.
- 3. Chapman, J.L. and Reiss, M.J. Ecology: Principles and Applications, Cambridge University Press, Cambridge, U.K. 2006.

H. Lecture Plan:

Lecture	Торіс	Session Outcome	Mode of	Correspo	Mode of assessing	
			Delivery	nding CO	the outcome	
Ι.	Horticulture: Fundamentals of plant	Inculcate knowledge about the horticulture and its	Lecture	BY 1602.1	MTE I	
	propagation	branches, research in horticulture			Quiz	
					End Term	
2.	A detailed account of pomology	Distinguish characteristics of the pomology and its status	Lecture	BY 1602.1	MTE I	
		in India regarding area of cultivation, production,			Quiz	
		contribution of India			End Term	
3.	Tutorial	Remembrance the general characteristic and institutes involved in horticulture research	Discussion	-	Class Test/ Quiz	
4.	Introduction to floriculture and	Describe the importance of floriculture and its status	Lecture	BY 1602.2	MTE I	
	applications				Quiz/ Class Test	
					End Term	
5.	Viticulture and its applications	Describe the importance of Viticulture and its status in	Lecture	BY 1602.3	MTE I	
		India			Quiz/ Class Test	
					End Term	
6.	Tutorial	Recall the importance of viticulture and floriculture in	Discussion	-	Class Test &	
		India			Assignments	
7.	Ornamental horticulture and its	Status of ornamental crops with example and their	Lecture	BY 1602.4	MTEI	
	applications	contribution in economy with aesthetic uses			Quiz/ Class Test	
					End Term	
8.	Oericulture and its applications	Examples of this branch of horticulture and its	Lecture	BY 1602.4	MIEI	
		contribution			Quiz/ Class Test	
	-		<u> </u>		End lerm	
9.	lutorial	Problem solving during the session regarding ornamental	Discussion	-	Class Test &	
		and olericulture crops	& Debate		Assignments	
10.	Applications of plant tissue culture in	Understand the role/ techniques of different tissues culture	Lecture	BT 1602.4		
	liorticulture	in norticulture, now tissue culture reduces the problem			Quiz/ Class Test	
	Development of reading and reasons	Which are existing in norticulture.	1			
11.	Development of garden and hursery	Nnow about the important parameters for garden and	Lecture	DI 1602.4		
		nursery development			Quiz/ Class Test	
10	Tutorial	Disquesion shout the femous betaging renders in built and	Disquestor			
12.	i utoriai	Discussion about the famous botanical gardens in India and	Discussion	-	Class Test	
1						
13.	Fundamentals of landscape design	Understand the concept of landscape design and its applicability	Lecture	BY 1602.4	MTE 2 Quiz/ Class Test End Term	
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14.	Principles and styles of landscape design	Understand various principles with examples of landscape designing in organizations and residential colonies	Lecture	BY 1602.4	MTE 2 Quiz/ Class Test End Term	
15.	Tutorial	Solve the queries of students regarding various types of landscape design	Discussion	-	MTE 2 Debate End Term	
16.	Propagation and conservation of plants	Understand the existing and latest techniques of plant propagation for their conservation	Lecture	BY 1602.5	MTE 2 Quiz/ Class Test End Term	
17.	Conservation strategies: <i>In situ</i> and <i>ex situ</i> conservation	Identify the various sanctuaries and national parks	Lecture	BY 1602.5	MTE 2 Quiz/ Class Test End Term	
18.	Tutorial	Discussion/ problem solving	discussion	-	Quiz/ Class Test End Term	
19.	Botanical gardens and biosphere reserves	Understand the concept of botanical gardens and identify various biosphere reserves	Lecture	BY 1602.4	MTE 2 Quiz/ Class Test End Term	
20.	Management of gardens	Know about the management of gardens regarding the maintenance and production of plant propagules and their marketing strategies	Lecture	BY 1602.4	MTE 2 Quiz/ Class Test End Term	
21.	Tutorial	Interaction with students for development of gardens and their management	Discussion	-	End Term Quiz/ Class Test	
22.	Introduction to industrial botany	Able to understand the concept of economic botany and the roles of plants contributing in the economic botany	Lecture	BY 1602.5	End Term Quiz/ Class Test	
23.	Organic farming and its applications	Understand the concept of organic farming and the advantages of organic farm products over chemically produced crop products	Lecture	BY 1602.5	End Term Quiz/ Class Test	
24.	Tutorial	Interaction with students regarding the status of organic farming and problems associated with it and applications	Discussion	-	Class Test	
25.	Biofuel and biodiesel	Identify the first, second generation biofuel crops and production of biofuel and biodiesel	Lecture	BY 1602.5	End Term Quiz/ Class Test	

26.	Applications of plants in cosmetic industry	Identify the plants which are useful in cosmetics	Lecture	BY 1602.5	End Term Quiz/ Class Test	
27.	Tutorial	Recall the plants useful in biofuel production and in cosmetics	Discussion	-	Class Test	
28.	Applications of plants in aroma therapy	Understand the concept of aroma therapy and essential oils.	Lecture	BY 1602.5	End Term Quiz/ Class Test	
29.	Important medicinal plants- Ashwgandha, Datura, Catharanthus, Curcuma, Ferula asafoetida	Aware about the principle active compounds present in these plants and their applications	Lecture	BY 1602.5	End Term Quiz/ Class Test	
30.	Tutorial	Recall the special essential oils and the medicinal plants	Discussion	-	Class Test	
31.	Plant used in pharmaceutical industry	Identify the plants useful in pharma industry	Lecture	BY 1602.5	End Term Quiz/ Class Test	
32.	Phytoremediation- Scope and applications	Understand the role of plants in remediation process	Lecture	BY 1602.6	End Term Quiz/ Class Test	
33.	Tutorial	Interaction and Discussion	Discussion	-	Class Test	
34.	Biodiversity and hot spots of the world	Know about the various hotspots and important biodiversity	Lecture	BY 1602.6	End Term Quiz/ Class Test	
35.	Centres of origin of major crop plants, Useful crop plants – Wheat, Rice and Maize	Understand the centre of origin of certain crop plants	Lecture	BY 1602.6	End Term Quiz/ Class Test	
36.	Tutorial	Doubt clearance and interaction	-	-	Class Test	
Lab Sessions	Know about the various vegetative propagation techniques along with uses of plant tissue culture in horticulture. Identify the plants for garden and nursery.	Able to apply techniques of plant propagation and maintenance of nursery and gardens	Lab sessions	BY 1602.1 BY 1602.4	Experimental results in 24 lab sessions End Term Practical Examination	

I. Course Articulation Matrix: (Mapping of COs with POs & PSOs)

со	STATEMENT		CORRELATION WITH PROGRAM OUTCOMES						CORRELATION WITH PROGRAM Specific OUTCOMES		
		PO I	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO I	PSO 2	PSO 3
[BY 1601.1]	Define common horticultural practices and techniques of plant propagation i.e. seed sowing, pruning & planting	I						I	I		
[BY 1601.2]	Discuss common vegetative propagation methods such as grafting, cutting and ground		1							I	
[BY 1601.3]	Classify the plants based on their various categories of uses like in olericulture, pomology,			2					I		1
[BY 1601.4]	Execute growth constraints and natural plant propagation techniques in nature	I								I	
[BY 1601.5]	Evaluate various environmental factors affect plant growth & development						2				
[BY 1601.6]	Design layout of greenhouse/ net house for manipulation of microclimate for the optimum growth of plants and develop employability skills						I		1		
L			<u> </u>								

I. Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation