Faculty of Science

Syllabus

For

B. Sc.

(IV Semester Course)

W.E.F. - Session 2025 - 2026

RADHA GOVIND UNIVERSITY
CHANDAUSI, SAMBHAL (U.P.)

B.Sc. 4thSemester

S. No.	Subject	Subject Code	Paper Title	Paper Code
1.	Web Designing	CP	Web designing	UWEBDCP201
			Web designing Lab I	UWEBDCP202
2.	Physics	PH	Wave and Optics	UWAVEPH203
			PhysicsLab IV	UPHYSPH204
3.	Chemistry	CH	Reactions, Reagents and Mechanisms in Organic Chemistry	UREACCH203
			Chemistry Lab IV	UCHEMCH204
4.	Mathematics	MA	Advanced Calculus and Partial differential equation	UADVAMA202
5.	Computer Science	CS	Object Oriented Programming with Java	UOBJECS203
			Computer Science Lab IV	UCOMPCS204
6.	Botany	BO	Plant Anatomy and Embryology	UPLANBO203
			Botany Lab IV	UBOTABO204
7.	Zoology	ZO	Physiology and Biochemistry	UPHYSZO203
			Zoology Lab IV	UZOOLZO204
8.	Biochemistry	BC	Intermediary Metabolism	UINTEBC203
			Biochemistry Lab IV	UBIOCBC204
9.	Microbiology	MB	Microbial Diversity and Growth	UMICRMB203
			Microbiology LabIV	UMICRMB204
10.	Biotechnology	BT	Recombinant DNA Technology	URECOBT203
			Biotechnology LabIV	UBIOTBT204
11.	Food Technology	FT	Food Microbiology	UFOODFT203
			Food technology Lab IV	UFOODFT204

	B.Sc. 4thSemester Course Structure – Faculty of Science
	Compulsory courses for B.Sc. 4th semester students (Level 6)

S. No.	Course	Subjects/Paper type/Total Credits	Paper Title	Paper Code	Credits	: Lecture T: Tutorial P: Practical			Distribution of Theory Marks		Distribution of Practical Marks		Total Marks (CCE+UE)
						L	T	P	CCE	UE	CCE	UE	
1.	PHYSICS	WEB DESIGNING/SEC/4	Web designing	UWEBDCP201	3	4	0	0	40	60	0	0	100
			Web designing Lab I	UWEBDCP202	1	0	0	4	0	0	40	60	100
2.		PHYSICS/ Major/6	Wave and Optics	UWAVEPH203	4	4	0	0	40	60	0	0	100
3.			Physics Lab IV	UPHYSPH204	2	0	0	4	0	0	40	60	100
4.		MATHEMATICS/Minor /6	Advanced Calculus and Partial differential equation	UADVAMA202	6	6	0	0	40	60	0	0	100
5.		CHEMISTRY/GE/4	Reactions, Reagents and Mechanisms in Organic Chemistry	UREACCH203	3	3	0	0	40	60	0	0	100
6.			Chemistry Lab IV	UCHEMCH204	1	0	0	2	0	0	0	100	100
	Total				**20**				**160**	**240**	**80**	**120**	**700**
1.	MATHEMATICS	WEB DESIGNING/SEC/4	Web designing	UWEBDCP201	3	4	0	0	40	60	0	0	100
			Web designing Lab I	UWEBDCP202	1	0	0	4	0	0	40	60	100
2.		MATHEMATICS/ Major/6	Advanced Calculus and Partial differential equation	UADVAMA202	6	6	0	0	40	60	0	0	100

3.		PHYSICS/Minor/6	Wave and Optics	UWAVEPH203	4	4	0	0	40	60	0	0	100
4.			Physics Lab IV	UPHYSPH204	2	0	0	4	0	0	40	60	100
5.		CHEMISTRY/GE/4	Reactions, Reagents and Mechanisms in Organic Chemistry	UREACCH203	3	3	0	0	40	60	0	0	100
6.			Chemistry Lab IV	UCHEMCH204	1	0	0	2	0	0	0	100	100
	Total				**20**				**160**	**240**	**80**	**120**	**700**
1.	**COMPUTER SCIENCE**	WEB DESIGNING/SEC/4	Web designing	UWEBDCP201	3	4	0	0	40	60	0	0	100
			Web designing Lab I	UWEBDCP202	1	0	0	4	0	0	40	60	100
2.		COMPUTER SCIENCE / Major/6	Object Oriented Programming with Java	UOBJECS203	4	4	0	0	40	60	0	0	100
3.			Computer Science Lab IV	UCOMPCS204	2	0	0	4	0	0	40	60	100
4.		PHYSICS/Minor/6	Wave and Optics	UWAVEPH203	4	4	0	0	40	60	0	0	100
5.			Physics Lab IV	UPHYSPH204	2	0	0	4	0	0	40	60	100
6.		MATHEMATICS /GE/4	Advanced Calculus and Partial differential equation	UADVAMA202	4	4	0	0	40	60	0	0	100
	Total				**20**				**160**	**240**	**120**	**180**	**700**
1.	**BOTANY**	WEB DESIGNING/SEC/4	Web designing	UWEBDCP201	3	4	0	0	40	60	0	0	100
			Web designing Lab I	UWEBDCP202	1	0	0	4	0	0	40	60	100
2.		BOTANY / Major/6	Plant Anatomy and Embryology	UPLANBO203	4	4	0	0	40	60	0	0	100
3.			Botany Lab IV	UBOTABO204	2	0	0	4	0	0	40	60	100
4.		ZOOLOGY /Minor/6	Physiology and Biochemistry	UPHYSZO203	4	4	0	0	40	60	0	0	100
5.			Zoology Lab IV	UZOOLZO204	2	0	0	4	0	0	40	60	100

6.		CHEMISTRY/GE/4	Reactions, Reagents and Mechanisms in Organic Chemistry	UREACCH203	3	3	0	0	40	60	0	0	100
7.			Chemistry Lab IV	UCHEMCH204	1	0	0	2	0	0	0	100	100
	Total				**20**				**160**	**240**	**120**	**280**	**800**
1.	**ZOOLOGY**	WEB DESIGNING/SEC/4	Web designing	UWEBDCP201	3	4	0	0	40	60	0	0	100
			Web designing Lab I	UWEBDCP202	1	0	0	4	0	0	40	60	100
2.		ZOOLOGY / Major/6	Physiology and Biochemistry	UPHYSZO203	4	4	0	0	40	60	0	0	100
3.			Zoology Lab IV	UZOOLZO204	2	0	0	4	0	0	40	60	100
4.		BOTANY /Minor/6	Plant Anatomy and Embryology	UPLANBO203	4	4	0	0	40	60	0	0	100
5.			Botany Lab IV	UBOTABO204	2	0	0	4	0	0	40	60	100
6.		CHEMISTRY/GE/4	Reactions, Reagents and Mechanisms in Organic Chemistry	UREACCH203	3	3	0	0	40	60	0	0	100
7.			Chemistry Lab IV	UCHEMCH204	1	0	0	2	0	0	0	100	100
	Total				**20**				**160**	**240**	**120**	**280**	**800**
1.	**CHEMISTRY**	WEB DESIGNING/SEC/4	Web designing	UWEBDCP201	3	4	0	0	40	60	0	0	100
			Web designing Lab I	UWEBDCP202	1	0	0	4	0	0	40	60	100
2.		CHEMISTRY / Major/6	Reactions, Reagents and Mechanisms in Organic Chemistry	UREACCH203	4	4	0	0	40	60	0	0	100
3.			Chemistry Lab IV	UCHEMCH204	2	0	0	4	0	0	40	60	100
4.		BOTANY /Minor/6	Plant Anatomy and Embryology	UPLANBO203	4	4	0	0	40	60	0	0	100
5.			Botany Lab IV	UBOTABO204	2	0	0	4	0	0	40	60	100
6.		ZOOLOGY /GE/4	Physiology and Biochemistry	UPHYSZO203	3	3	0	0	40	60	0	0	100
7.			Zoology Lab IV	UZOOLZO204	1	0	0	2	0	0	0	100	100
	Total				**20**				**160**	**240**	**120**	**280**	**800**

1.	**BIOTECHNOLOGY**	WEB DESIGNING/SEC/4	Web designing	UWEBDCP201	3	4	0	0	40	60	0	0	100
			Web designing Lab I	UWEBDCP202	1	0	0	4	0	0	40	60	100
2.		BIOTECHNOLOGY / Major/6	Recombinant DNA Technology	URECOBT203	4	4	0	0	40	60	0	0	100
3.			Biotechnology Lab IV	UBIOTBT204	2	0	0	4	0	0	40	60	100
4.		BIOCHEMISTRY /Minor/6	Intermediary Metabolism	UINTEBC203	4	4	0	0	40	60	0	0	100
5.			Biochemistry Lab IV	UBIOCBC204	2	0	0	4	0	0	40	60	100
6.		FOOD TECHNOLOGY /GE/4	Food Microbiology	UFOODFT203	3	3	0	0	40	60	0	0	100
7.			Food technology Lab IV	UFOODFT204	1	0	0	2	0	0	0	100	100
	Total				**20**				**160**	**240**	**120**	**280**	**800**
1.	**MICROBIOLOGY**	WEB DESIGNING/SEC/4	Web designing	UWEBDCP201	3	4	0	0	40	60	0	0	100
			Web designing Lab I	UWEBDCP202	1	0	0	4	0	0	40	60	100
2.		MICROBIOLOGY / Major/6	Microbial Diversity and Growth	UMICRMB203	4	4	0	0	40	60	0	0	100
3.			Microbiology Lab IV	UMICRMB204	2	0	0	4	0	0	40	60	100
4.		BIOTECHNOLOGY /Minor/6	Recombinant DNA Technology	URECOBT203	4	4	0	0	40	60	0	0	100
5.			Biotechnology Lab IV	UBIOTBT204	2	0	0	4	0	0	40	60	100
6.		FOOD TECHNOLOGY /GE/4	Food Microbiology	UFOODFT203	3	3	0	0	40	60	0	0	100
7.			Food technology Lab IV	UFOODFT204	1	0	0	2	0	0	0	100	100
	Total				**20**				**160**	**240**	**120**	**280**	**800**
1.	**BIOCHEMISTRY**	WEB DESIGNING/SEC/4	Web designing	UWEBDCP201	3	4	0	0	40	60	0	0	100
			Web designing Lab I	UWEBDCP202	1	0	0	4	0	0	40	60	100
2.		BIOCHEMISTRY / Major/6	Intermediary Metabolism	UINTEBC203	4	4	0	0	40	60	0	0	100

3.			Biochemistry Lab IV	UBIOCBC204	2	0	0	4	0	0	40	60	100
4.		BIOTECHNOLOGY /Minor/6	Recombinant DNA Technology	URECOBT203	4	4	0	0	40	60	0	0	100
5.			Biotechnology Lab IV	UBIOTBT204	2	0	0	4	0	0	40	60	100
6.		FOOD TECHNOLOGY /GE/4	Food Microbiology	UFOODFT203	3	3	0	0	40	60	0	0	100
7.			Food technology Lab IV	UFOODFT204	1	0	0	2	0	0	0	100	100
	Total				**20**				**160**	**240**	**120**	**280**	**800**
1.	**FOOD TECHNOLOGY**	WEB DESIGNING/SEC/4	Web designing	UWEBDCP201	3	4	0	0	40	60	0	0	100
			Web designing Lab I	UWEBDCP202	1	0	0	4	0	0	40	60	100
2.		FOOD TECHNOLOGY / Major/6	Food Microbiology	UFOODFT203	4	4	0	0	40	60	0	0	100
3.			Food technology Lab IV	UFOODFT204	2	0	0	4	0	0	40	60	100
4.		BIOTECHNOLOGY /Minor/6	Recombinant DNA Technology	URECOBT203	4	4	0	0	40	60	0	0	100
5.			Biotechnology Lab IV	UBIOTBT204	2	0	0	4	0	0	40	60	100
6.		MICROBIOLOGY /GE/4	Microbial Diversity and Growth	UMICRMB203	3	3	0	0	40	60	0	0	100
7.			Microbiology Lab IV	UMICRMB204	1	0	0	2	0	0	0	100	100
	Total				**20**				**160**	**240**	**120**	**280**	**800**

B.Sc. 4th Semester

Syllabus

Subject- Web Designing
Course Title: Web Development using PHP & MySQL
Subject code: UWEBDCP201

Unit: I Basics of PHP (No. of Lectures: 6)
Introduction to PHP, PHP features installation of XAMPP/WAMP, Benefits of using PHP MYSQL, Server Client Environment, Web Browser, and Web Server Installation & Configuration Files.
OOPs with PHP, language basics, syntax, comments, variables, constants and data types, expressions and operators, flow control statements, looping structures, Arrays
Including html code in PHP, Embedding PHP in web pages.
Unit: II Functions & Strings in PHP (No. of Lectures: 6)
Defining a function, Calling a function, variable scope, function parameters, return values, User Defined Function, System Defined Function, Parameterized Function, Date & Time Function, Hash Function, Mail Function, predefined functions.
Strings: Creating & accessing string, searching and replacing strings, encoding and escaping, comparing strings, formatting strings, regular expression.
Unit: III Data & File Handling (No. of Lectures: 6)
PHP Forms: $_GET, $_ POST, $_REQUEST, $_ FILES, $_SERVER, $GLOBAL, $_ENV, input/output controls, validation, cookies and Sessions.
File Handling: File and directory, open, close, read, write, append, delete, uploading and downloading files. File exists, File Size, Rename. Reading and display all/selected tiles present in a directory.
Unit: IV MySQL an Overview (No. of Lectures: 6)
Introduction, what is a Database, Understanding an RDBMS, Tables, Record & Fields, SQL Language.
Working with phpmyadmin: Creating and using a database, Selecting a database, creating I dropping a table, loading data into a table, Retrieving information from a table, selecting all data, selecting particular rows, selecting particular columns, writing queries, sorting, date, calculations, working with NULL values, pattern matching, counting rows, using more than one tables, using table and column aliases.
Unit: V MySQL, DATABASES IN PHP (No. of Lectures: 6)
Introduction, connecting to a MySQL database, querying the database, Retrieving and displaying the results, modifying data and deleting data through front end. Designing applications using PHP & MySQL.

Web designing Lab I
UWEBDCP202

- Create a simple HTML form and accept the user name and display the name through PHP echo statement.
- Write a PHP script to demonstrate arithmetic operators, comparison operator, and logical operator.
- Write PHP Script to input marks, generate result and display grade.
- Write PHP Script for addition of two 2x2 matrices.
- Write PHP script to obtain factorial of a number using function.
- Write PHP script to demonstrate string, date and math function.
- Create student registration form using text box, check box, radio button, select, submit button. And display user inserted value in new PHP page.
- Write two different PHP script to demonstrate passing variables through a URL
- Write two different PHP script to demonstrate passing variables with sessions.
- Write PHP script to demonstrate passing variables with cookies.
- Write a program to keep track of how many times a visitor has loaded the page.
- Write PHP script to demonstrate exceptional handling.
- Write a P1-IF script to connect MySQL server from your website.
- Create EMP table with emp_no, emp_name, designation and salary. Write a program to read employee information from EMP table and display all this information in PHP page.
- Create customer table in MySQL with cust_no, cust_name, item purchased, and mob no, insert 10 records into it.
- Write a program to read customer information from customer table and display all these information in table format on PHP page.
- Deigns a web form in PHP to input values for the customer record and insert the record in customer table as a tuple.
- Design an "update- web form to edit name of customer to "Bob" with cust_no 1
- Design a "delete web form to delete record with custno=3.
- Create a dynamic web site using PHP and MySQL.

Learning Resources
Text Books, Reference Books, Other resources
Suggested Readings:

- Head First PHP & MySQL, Lynn Beighley & Michael Morrison, O'Reilly
- PHP: A Beginner's Guide, Vikram Vaswani, McGraw-Hill Edition
- Learning PUP, MySQL, JavaScript, & CSS: A Step-by-Step Guide to Creating Dynamic Websites, Robin Nixon, O'Reilly
- PHP and MySQL Web Development, Luke Welling, Addison-Wesley
- The Joy of PHP, Alan Forbes, BeakCheck LLC
- Learning PHP, MySQL, JavaScript, & CSS: A Step-by-Step Guide to Creating Dynamic Websites, Robin Nixon, O'Reilly

Subject- Physics
Course Title: Wave and Optics
UWAVEPH203

Unit: I Waves (No. of Lectures: 12)

Superposition of Two Collinear Harmonic oscillations: Linearity and Superposition Principle: (1) Oscillations having equal frequencies and (2) Oscillations having different frequencies (Beats).

Superposition of Two Perpendicular Harmonic Oscillations: Graphical and Analytical Methods; Lissajous Figures (1:1 and 1:2) and their uses.

Wave Motion: Transverse waves on a stretched string; Travelling and standing waves; Normal Modes of a string; Phase velocity; Group velocity; Plane and Spherical waves; Wave intensity.

Keywords/Tags: Harmonic Oscillation, Superposition Principle, Wave Motion.

Unit: II Sound and light wave (No. of Lectures: 12)

Sound: Simple harmonic motion; Forced vibrations and resonance; Fourier's Theorem; Application to saw tooth wave and square wave; Intensity and loudness of sound; Decibels, Intensity levels; Musical notes; Musical scale.

Acoustics of buildings:Reverberation and time of reverberation; Absorption coefficient; Sabine's formula; Measurement of reverberation time; Acoustic aspects of halls and auditoria.

Wave optics: Electromagnetic nature of light; Wave front; Huygens Principle.

Electro-optic, Magneto-optic and acousto-optic effects (elementary idea).

Keywords/Tags: Sound, Musical notes, Acoustics of buildings, Wave optics.

Unit: III Interference of Light (No. of Lectures: 12)

Interference: Interference by Division of amplitude and division of wave front; Young's Double Slit experiment; Lloyd's Mirror and Fresnel's Bi prism.

Interference in Thin Films: Stokes' Law; Interference in parallel and wedge-shaped films; Fringes of equal inclination (Haidinger Fringes); Fringes of equal thickness (Fizeau Fringes); Applications of thin films interference: Antireflection coating; Dielectric Mirrors; Interference filter.

Newton's Ring: Measurement of wavelength and refractive index.

Michelson's Interferometer: (I) formation of fringes, (2) Determination of wavelength, (3) Wavelength difference, (4) Refractive index, (5) Visibility of fringes.

Keywords/Tags: Interference, Thin films interference, Michelson's Interferometer

Unit: IV Diffraction (No. of Lectures: 12)

Introduction; Distinction between interference and diffraction; Types of diffraction; Distinction between Fresnel and Fraunhofer diffraction.

Fresnel's diffraction: Fresnel's Assumptions; Huygens — Fresnel's Theory; Half period zone; Construction and theory of Zone plate; Diffraction at straight edge; Diffraction at a circular aperture.

Fraunhofer diffraction: Diffraction due to single, double

and N slits; Plane diffraction grating.
Resolving and dispersive power: Rayleigh's criterion;
Limit of resolution of the eye; resolving power of Grating and Telescope; Expression for dispersive power of prism.
Keywords/Tags: Diffraction, Zone plate, Plane diffraction grating, Resolving power
Unit: V Polarisation (No. of Lectures: 12)
Introduction: Polarized light and its representation; Difference in Polarized and polarized light; Types of Polarization; Application of polarization: Sunglasses; Three-dimensional movies; Photography.
Production of polarized light: Production of polarized light by reflection, refraction, scattering and selective absorption; Brewster's Law; Polaroid sheets; Polarizer and analyzer; Malus law.
Anisotropic Crystals: Doubly refracting crystals (Uniaxial); Extra-ordinary rays and Ordinary rays; Polarization by double refraction and Huygens theory; Nicol prism;
Retardation plates: Quarter-wave plate and Half- wave plate.
Optical Activity: Optical rotation; Specific rotation; half shade & Biquartz polarimeter.
Keywords/Tags: Polarized light, Anisotropic Crystals, Optical Activity.

Learning Resources
Text Books, Reference Books, Other resources
Suggested Readings:

- Bajaj N. K., "The Physics of Waves and Oscillations", Tata McGraw Hill, 1998.
- Pain H. J., "The Physics of Vibrations and Waves", John Wiley and Sons, 2013.
- Ghatak Ajoy, "Optics", Tata McGraw Hill, 2008.
- Kumar A., Gulati H. R. and Khanna D. R., "Fundamental of Optics", R. Chand Publications.
- Subrahmaniyam N. & et Al, "A Text Book of Optics", S Chand.

Physics Lab IV
UPHYSPH204

- To study Lissajous Figures with the help of CRO.
- To determine the Frequency of an Electrically Maintained Tuning Fork by Melde's experiment.
- To determine the angle of minimum deviation using i- δ curve by spectrometer.
- To determine the Refractive Index of the Material of a given prism using Sodium Light.
- To determine Dispersive Power of the Material of a given Prism using Mercury Light.
- To determine Cauchy constant for the material of a prism using the spectrometer.
- To determine wavelength of sodium light using Fresnel Biprism.
- Determine the radius of curvature of a Plano - convex lens by Newton's rings.
- To determine the refractive index of a liquid using Newton's ring.
- To determine wavelength of Sodium light (D1 and D2 lines)using plane diffraction Grating.
- To determine the Resolving power of a plane Diffraction Grating.
- Determination of specific rotation of sugar solution by polarimeter.
- Determination of resolving power of a telescope.
- To determine diameter/thickness of a thin wire by diffraction method.
- To determine the wavelength of sodium source using Mischelson's interferometer.
- Study of diffraction at straight edge.
- Verification of Brewster's law with the help of spectrometer.
- To determine the wavelength of laser light with the help of plane transmission grating.
- Calculation of height of a object with the help of Sextant.
- Calculation of μo and μe of calcite/ quartz with the help of spectrometer.

Learning Resources
Text Books, Reference Books, Other resources
Suggested Readings:

- Prakash I. & Ramakrishna, "A Text Book of Practical Physics", Kitab Mahal, 2011, 11/e.
- Squires G.L., "Practical Physics", Cambridge University Press, 2015, 4/e.
- Chattopadhyay D. & Rakshit P. C., "An Advanced Course in Practical Physics", New Central Book Agency.
- Srivastava J.P., "Elements of Solid state Physic", PHI Publication.

Subject- Chemistry

Course Title: Reactions, Reagents and Mechanisms in Organic Chemistry

UREACCH203

Unit: I Substitution reactions (No. of Lectures: 12)

Aliphatic Nucleophilic Substitution: Introduction, the SN1, SN2 and SNi mechanisms, neighboring group participation, effect of substrate, nucleophile, leaving group and reaction medium.

Aliphatic Electrophilic Substitution: Elementary treatment.

Aromatic Nucleophilic Substitution: the SNAr, SN1 and Benzene mechanisms, effect of substrate, nucleophile, leaving group and reaction medium.

Aromatic Electrophilic Substitution: Arenium ion mechanism, orientation/ directive influence (electronic explanation only) and reactivity, diazonium coupling, Vilsmeir reaction.

Keywords/Tags: Nucleophilic Substitution, Electrophilic Substitution, Benzene, SN1, SN2, SNi, SNAr.

Unit: II Addition and Elimination Reactions (No. of Lectures: 12)

Addition Reactions: Introduction, reactions involving addition of nucleophile, electrophile and free radicals, regio-selectivity and chemo-selectivity, orientation and reactivity, Markovnikov and Anti, Markovnikov's addition.

Elimination Reactions: Introduction, E1, E2 and E1cB mechanism, effect of substrate, attacking species, leaving group and reaction medium, orientation- Saytzeff and Horimann rule.

Keywords/Tags: Addition Reactions, Elimination,, Reactions ,Saytzeff
Rule, Markovnikov addition, regio-selectivity, chemo-selectivity.

Unit: III Reagents, Catalysts and Rearrangements (Mechanism and Application)s (No. of Lectures: 12)

Reagents and Catalysts: Preparation, properties and applications of important reagents and catalysts 'in, Organic synthesis with mechanistic details: Grignard reagent, Nc bromo succanimide (NBS), diazomethane, anhydrous aluminum chloride (AlC13), sod amide (NaNH2), Ziegle-Natta catalyst.

Rearrangements,(Reaction, Mechanism &Applications):
Introduction, Types of Rearrangements, Rearrangement to Electron
Deficient Carbon (Pinacol--pinacolone, benzilic acid & Wagner-
Meerwein), Rearrangement to Electron Deficient Nitrogen (Hofinann- Lossen-Cuitius & Beckmann), Rearrangement to Electron Deficient Oxygen (Baeyer-Villiger & Dakin), Rearrangement to Electron-Rich Carbon (Wittig), Aromatic Rearrangements (Fries & Claisen).

Key words/Tags: Rearrangement, Reagent, catalyst, NBS, sodamide, 'G.rignard.

Unit: IV Oxidation & Reduction Reactions (No. of Lectures: 12)

Oxidation Reactions: Introduction, metal based and non-metal based oxidations, oxidation of alcohols to carbonyls (chromium, manganese, and silver based reagents), alkenes to epoxides (peroxides / per acids based, alkenes to diols (manganese and osmium based), alkenes to carbonyls with bond cleavage (manganese and lead based), and Oppenauer oxidation. Oxidation of amino groups to nitro groups: oxidation by alkaline KmnO4, oxidation of aliphatic and aromatic amines by per acids, oxidation of primary and secondary amines to hydroxyl amine by hydrogen peroxide.

Reduction Reactions: Introduction, Reduction of carbon- carbon multiple bonds, carbonyl groups and nitro compounds: catalytic hydrogenation: heterogeneous (palladium- carbon & Raney Nickel), homogeneous (Wilkinson's catalyst)
Hydride transfer reagent: Sodium borohydride and Lithium aluminum hydride, Metal based reduction: Birch reduction Clemmensen Reduction.
Reduction of nitro compounds by catalytic hydrogenation and metals (with mechanism).
Keywords/ Tags: oxidation, reduction, hydrogenation, Wilkinson's catalyst, Metal- based reduction.

Unit: IV Photochemical and pericyclic reactions (No. of Lectures: 12)
Photochemical reactions: Introduction to photochemistry, electronic excitations, Jablonski diagram, Norrish type I and II reactions and cis-trans isomerization.
Pericyclic reactions: Introduction of pericyclic reaction and their classification (Electrocyclic, Sigmatropic rearrangement and cycloadditions), 2+2 and 4+2 cycloadditions, Claisen and Cope rearrangement.
Keywords/Tags: Photochemistry, Pericyclic Reactions, Norrish reactions, Cycloadditions reaction.

Learning Resources
Text Books, Reference Books, Other resources
Suggested Readings:

- Ahluwalia, V. K. and Parashar R. K., "Organic Reaction Mechanisms", Narosa. Publication, India, 2010, Fourth Edition.
- Goswami, C., "Snatkottar Prakash Rasayan evm Thos Avastha Rasayan", Hindi Granth Academy, Bhopal, Madhya Pradesh, 2019.
- Singh, J. and Singh, J., "Photochemistry and Pericyclic Reactions", New Academic Science, UK, 2012, Third Edition.
- Wardle, B., "Principles and Applications of Photochemistry", Jolui Wiley & Sons, UK, 2009.
- Dhinda, B., "Essentials of Pericyclic and Photochemical Reactions", Springer
- International Publishing Switzerland, 2017.
- Books published by M.P. Hindi Granth Academy, Bhopal

Chemistry Lab IV
UCHEMCH204

Part – A Qualitative Analysis (No. of Lectures: 20)
Separation of binary organic mixture (by solvent and chemical separation method), systematic identification of separated organic compounds and preparation of their derivatives.
Keywords/Tags: Qualitative Analysis, Separation, binary organic mixture, organic derivative.
Part – B Organic Reactions and Reagents: (No. of Lectures: 20)
Oxidation reactions: Synthesis, monitoring of the reaction using TLC, purification of product and determination of melting point.
Oxidation of benzaldehyde to benzoic acid by potassium permanganate.
Oxidation of cyclohexane to adipic acid by nitric acid
Reduction Reactions: Synthesis, monitoring of the reaction using TLC, purification of product and determination of melting point.
Reduction of benzophenone to benzhydrol by sodium borohydride.
Reduction of acetophenone to ethyl benzene (Wolff- Kishner reduction).
Photochemical and Pericyclic reactions:
(4+2) Cycloadditions reaction of anthracene and maleic anhydride (Diels- Alder reaction).
Photochemical synthesis of benzpinnacol from benzophenone.
Rearrangement Reactions:
Pinacol- pinacolone Rearrangement (benzpinnacol →benzpinacolone).
Benzil- benzilic acid Rearrangement.
Keywords/ tags: Oxidation, Reduction, Rearrangement, TLC, Cycloadditions, Photochemical Reaction, Pericyclic Reaction.
Part – C Two step Organic Preparations, purification of product and determination of melting point.
Acetanilide→ Para- bromo acetanilide → Para- bromo aniline.
Acetanilide → Para- nitro acetanilide → Para- nitroaniline.
Keywords/Tags: Organic preparation, Acetanilide, Bromination, Nitration, Hydrolysis.

Learning Resources
Text Books, Reference Books, Other resources
Suggested Readings:

- Tatchell A.R., Furnis B.S., Hannaford A.J., Smith P.W.G., "Vogel's Textbook of Practical Organic Chemistry", Pearson Education, India, 2003, Fifth Edition.
- Ahluwalia V. K., Dhingra S., "Comprehensive Practical Organic Chemistry: Qualitative Analysis, Universities Press, India, 2000.
- Book published by M.P. Hindi Granth Academy, Bhopal

Subject- Mathematics
Course Title: Advanced Calculus and Partial differential equation
UADVAMA202

Unit: I (No. of Lectures: 18)
1.1 Historical background
1.1.1 A brief historical background of Calculus and partial differential equations in the context of India and Indian heritage and culture
1.1.2 A brief biography of Bodhayana
1.2 Field structure and ordered structure of R, intervals, bounded and unbounded sets, supremum and infimum, completeness in R, absolute value of a real number.
1.3 Sequence of real numbers
1.4 Limit of a sequence
1.5 Bounded and monotonic sequences
1.6 Cauchy's general principle of convergence
1.7 Algebra of sequence and some important theorems
Unit: II (No. of Lectures: 18)
2.1 Series of non-negative terms
2.2 Convergence of positive term series
2.3 Alternating series and Leibnitz's test
2.4 Absolute and Conditional Convergence of Series of real terms
2.5 Uniform continuity
2.6 Chain rule of differentiability
2.7 Mean value theorems and their geometrical interpretations
Unit: III (No. of Lectures: 18)
3.1 Limit and continuity of functions of two variables
3.2 Change of variables
3.3 Euler's theorem on homogeneous functions
3.4 Taylor's theorem for functions of two variables
3.5 Jacobians
3.6 Maxima and Minima of functions of two variables
3.7 Lagrange's multiplier method
3.8 Beta and Gamma Functions
Unit: IV (No. of Lectures: 18)
4.1 Partial differential equations of the first order
4.2 Lagrange's solution
4.3 Some special types of equations which can be solved easily by methods other than the general method
4.4 Charpit's general method
4.5 Partial differential equations of second and higher orders
Unit: V (No. of Lectures: 18)
5.1 Classification of partial differential equations of second order
5.2 Homogeneous and non-homogeneous partial differential equations of constant coefficients
5.3 Partial differential equations reducible to equations with constant coefficients

Keywords/Tags:
Bodhayana, Sequence, Series, Jacobians, Maxima and Minima, Beta and Gamma functions, Partial differential equations.

Learning Resources
Text Books, Reference Books, Other resources
Suggested Readings:

- Devi Prasad: Advanced Calculus, Prentice Hall India Learning Private Limited, 2009
- S C Malik and Savita Arora: Mathematical Analysis, New Age International Private Limited, 1st edition, 2017.
- M. D. Raysinghania: Ordinary and Partial Differential Equations, S. Chand & Company, New Delhi, 2017.
- Gerard G. Emch, R. Sridharan and M. D. Srinivas: Contributions to the History of Indian Mathematics. Hindustan Book Agency, Vol. 3, 2005.
- R. R. Gold beg: Methods of Real Analysis, Oxford & I.B.H. Publishing co. New Delhi, 2020.
- T. M. Apostol: Mathematical Analysis, Narosa Publishing House. New Delhi. 1985.
- D. Soma Sundaram and B. Choudhary: A first Course in mathematical Analysis, Narosa Publishing, House, New Delhi, 1997.

Subject- Computer Science
Course Title: Object Oriented Programming with Java
UOBJECS203

Unit: I (No. of Lectures: 12)
OOPS - Object Oriented Paradigm, Benefits of 00P, and Applications of OOP.
Java - History, Java Features, How Java Differs from C and C++, Java and interne, Java and World Wide Web, Web Browsers, Hardware and Software Requirements, Java Supports Systems, Java Environment.
Java Program Structure - Java Tokens, Java Statements, Implementing a Java Program, Java Virtual Machine, Command Line Arguments, and Programming Style.
Keywords: OOPS, JVC, WWW, Java Environment

Unit: II (No. of Lectures: 12)
Java Basics -Constants, Variables, Data Types, Declaration of Variables, Giving Values to Variables, Scope of Variable, Symbolic Constants, Type Casting, Getting Values of Variables, Standard Default Values.
Operators - Arithmetic Operator, Relational Operators, Logical Operators, Assignment Operators, Increment and `Decrement Operators, Conditional Operators, Bitwise Operators, Special Operators,
Arithmetic Expressions - Evaluation of Expressions, Precedence of Arithmetic Operators, Type Conversions in Expressions, Operator Precedence and Associativity, Mathematical Functions.Decision Making with if Statement, Simple if Statement, if…Else Statement, Nesting of if ...else Statement, if-else Ladder, The Switch Statement, The Operator.
Loops - While Statement, Do Statement, For Statement, Jump in Loops, Labeled Loops.
Keywords: Operators Arithmetic Expressions, Decision Making, Loops

Unit: III (No. of Lectures: 12)
Class - Defming a Class, Adding Variables, Adding Methods, Creating Objects, Accessing Class Members.
Constructors — definition and types, Methods Overloading, Static Members, Nesting of Methods.
Inheritance - Extending a Class, Overloading Methods, Final Variables and Methods, Final Classes, Finalize Methods, Abstract Methods and Classes, Visibility Control Arrays, One Dimensional Array, Strings, Vectors, Wrapper Classes. Defining Interfaces, Extending Interfaces, Implementing Interfaces, Accessing Interface Variables.
Keywords: Class, Constructors, Inheritance, Final, Abstract Methods, Overloading

Unit: IV (No. of Lectures: 12)
Java API Packages - Using System Packages, Naming Conventions, Creating Packages, Accessing a Package, Using a Package, Adding a Class to a Package, and Hiding Classes.
Creating Threads, Extending the Thread Class, Stopping and Blocking a Threads, Life Cycle of a Thread, Using Threads Methods, Threads Exceptions, Threads Priority, Synchronization, Implementing the 'Runnable' interface.
Types of Errors - Exceptions, Syntax of Exception Handling Code, Multiple Catch Statements, Using Finally Statements, Throwing Our Own Exceptions, Using Exceptions for Debugging.
Preparing to Write Applets - Building Applet Code, Applet Life Cycle, Creating an Executable Applet, Designing a Web Page, Applet Tag, Adding Applet to HTML File,

Running the Applet.
Keywords: API, threads, synchronization, errors, Applets, debugging
Unit: V (No. of Lectures: 12)
More About the Applet tag - Passing Parameters to Applets, Aligning the Display, More about HTML Tags, Displaying Numbering Values, Getting Input from the user.
The Graphics Class - Lines and Rectangles, Circles and Ellipses, Drawing Arcs, Drawing Polygons, Line Graphs, Using Control Loops in Applets, Drawing Bar Charts.
Concept of Stream - Stream Classes, Byte Stream Classes, Character Stream Classes, Using Streams,
Other Useful I/O. Classes - Using the File Class, Input / Output Exceptions, Creation of Files, Reading / Writing Characters, Reading / Writing Bytes, Handing Primitive Data Types, Concatenating and Buffering Files, Random Access, Files, Interactive Input and Output, other Stream Classes.
Keywords: Stream, files, Graphics class, buffering, HTML tags

Learning Resources
Text Books, Reference Books, Other resources
Suggested Readings:

- E Balguruswami, Programming with Java, Tata McGraw-Hill Publication.
- Bruce Eckel, Thinking in Java.
- Herbert Schildt, Java: The Complete Reference.
- Y. Daniel Liang, Introduction to Java Programming.
- Paul Deitel, Harvey Deitel, Java: How To Program.
- Cay S. Horsttnann, Core Java Volume I —Fundamentals.
- Java Projects, BPB Publication.
- Dr. S.S. Kandare, Programming in Java, S Chand Publication.
- Books published by M.P. Hindi Granth Academy, Bhopal

Computer Science Lab IV
UCOMPCS204

- Find greater number between two numbers- using conditional operator.
- Find the factorial of number if number is given by user using command line argument.
- Write a program to check if a number is prime or not.
- Write a program to display tables from 2 to 10.
- Write a program to print Fibonacci series.
- Enter a no. and check whether it is even or odd.
- Write a program to find sum & average of 10 no. using arrays.
- Write a program to display reverse of a digit no. using array.
- Write a program to demonstrate function overloading.
- Write a program to display grade according to the marks obtained by the student.
- Write a program to calculate the salary of an employee if salary is greater than or equal to 20000 and year of service is greater than or equal to 5 years then bonus will be 2000 otherwise 1000 and print grass salary of employee.
- Write a program to convert the given no. of days into months & days using with classes, objects and method.

- Write a program to convert given string into Uppercase and lowercase and get the length of string using array.
- Create a package called “Arithmetic” that contains methods to deal all arithmetic operations. Also write a program to use the package.
- Write a program to demonstrate use of constructor and destructor.
- Define an exception called “Marks out of Bound” exception that is thrown if the entered marks are greater than 100.
- Write a program using application of single inheritance. Find the area of rectangle & volume of cube.
- Develop a simple real life application to illustrate the use of multithreading.
- Write a program using multiple inheritances to calculate area and perimeter of a circle using interface.
- Write an applet program to draw a Rectangle (colour= orange) and a right aligned oval.
- Develop an applet that receives 3 numeric values as inputs from the user and then displays the largest no. on the screen.
- Write a Java Program to read data from the inputted text file name, and print its content on the console.
- Write a Java Program to merge two files into third file.
- Write a Java program to delete duplicate lines in text file.
- Write a Java Program to implement File Input Stream class to read binary data from any image file.

Learning Resources
Text Books, Reference Books, Other resources
Suggested Readings:

- E. Balguruswami, Programming with Java, Tata McGraw- Hill Publication, 2nd edition.
- Books published by M.P. Hindi Granth Academy, Bhopal
- Herbert Schildt, Java: The Complete Reference (9e)
- Y. Daniel Liang, Introduction to Java Programming (10e)
- Paul Deitel, Harvey Deitel, Java: How to Program (10e)
- Java projects, BPB Publication.

Subject- Botany
Course Title: Plant Anatomy and Embryology
UPLANBO203

Unit: I (No. of Lectures: 12)
Meristematic and permanent tissues
1.1 Types of meristems,
1.2 Organization of Root and shoot apex
1.3 Simple and complex tissues.
1.4 Special type of tissues.
1 .5Structure of dicot and monocot root, stem and leaf Kranz anatomy.
1.6 Pits and plasmodesmata;
1.7 Wall ingrowths and transfer cells.
1.8 Hydathodes, cavities, lithocysts and laticefers
Unit: II (No. of Lectures: 12)
Secondary Growth:
1.1 Vascular cambium - structure, function and seasonal activity.
1.2 Secondary growth in root and stem,
1.3 Wood (heartwood and sapwood).
1.4 Anomalous structures.
1. 5Adaptive and protective systems: Epidermis, cuticle, stomata;
1. 6General account of adaptations in xerophytes and hydrophytes.
1.7 Dendrochronology.
Unit: III (No. of Lectures: 12)
Embryology:
1.1 History and Importance of embryology,
1.2 Structure of flower, anther and pollen,
1.3 Micro-sporogenesis and Mega-sporogenesis;
1.4 Structure and types of ovules;
1.5 Types of embryo sacs,
1.6 Organization and ultra-structure of mature embryo sac.
Unit: IV (No. of Lectures: 12)
Pollination and fertilization
1.1 Types of Anthers and pollen,
1.2 Pollination mechanisms and adaptations;
1.3 Pollen pistil interaction,
1.4 Double fertilization;
1.5 Post fertilization changes,
1.6 Seed structure appendages and dispersal mechanisms.
1.7 Palynology and Scope (a brief account)
Unit: V (No. of Lectures: 12)
Endosperm & embryo
1.1 Endosperm types, structure and functions;
1.2 Dicot and monocot embryos;
1.3 Embryo- endosperm relationship,

1.4 Nutrition of Embryo
1.5 Unusual features in Embryo and Endosperm,
1.6 Apomixis and polyembryony, Definition, types and practical applications.
1.7 In- vitro fertilization
Keywords/Tags: Meristematic and permanent tissues, plasmodesmata, Hydathodes, cavities, lithocysts, laticefers, Secondary Growth, Vascular cambium Wood, Xerophytes, hydrophytes, Dendrochronology, Embryology , Embryo-sac, Pollination, Fertilization, Embryo, Endosperm Apomixis ,polyembryony

Learning Resources
Text Books, Reference Books, Other resources
Suggested Readings:

- Bhojwani, S.S. & Bhatnagar, S.P. (2011). Embryology of Angiosperms. Vikas Publication House Pvt. Ltd. New Delhi. 5th edition.
- Dickison, W.C. (2000). Integrative Plant Anatomy. Harcourt Academic Press, USA.
- Palm, A. (1974). Plant Anatomy. Pergmon Press, USA.
- Mauseth, J.D. (1988). Plant Anatomy. The Benjammin/Cummings Publisher, USA.
- Evert, R.F. (2006) Esau's Plant Anatomy: Meristems, Cells, and Tissues of the Plant Body: Their Structure, Function and Development. John Wiley and Sons, Inc.
- Johri, B.M.(1984)Embryology of Angiosperms.Springer-Verlag, Berlin Heidelberg.
- Mahenshwari,P. Indroduction of embryology of Angiospem, Tata magrohill publication corn. (1971)
- Pandey, B.P. plant anatomy S. Chand & company (1986)

Botany Lab IV
UBOTABO204

Unit I-V (No. of Lectures: 30)

- Study of meristems through permanent slides and photographs.
- Study of Tissues (parenchyma, collenchyma and sclerenchyma); Macerated axillary element, Phloem (Permanent slides, photographs)
- Study of Monocot stem: Maize (Zea mays); Dicot stem: Sunflower (Helianthus); Secondary growth: Helianthus.
- Study of Monocot root: Maize (Zea mays); Dicot stem: Sunflower (Helianthus); Secondary growth: Helianthus
- Study of Dicot and Monocot Leaf.
- Study of anomalous structure in Achyranthes, Boerhaavia, Nyctanthes through section cutting.
- Study of Xerophyte (Nerium leaf) and Hydrophyte (Hydrilla stem), Plants.
- Study of anther (young and mature), tapetum (amoeboid and secretory) through Permanent slide/ pictures.
- Study of female gametophyte Polygonum (monosporic) type of embryo sac development through permanent slide/ photographs.
- Study of mature egg apparatus through slides/ photographs.

- Demonstration of different types of Pollination and seed dispersal.
- Study of percentage germination of pollen grain in a given medium.
- Demonstration of pollen germination, types of ovules in plants and placentation through temporary slides/ photographs/ permanent slide.

*section cutting, study of pollen grain and stigma through locally available plant.

Keywords/ Tags: meristems, tissues, Monocot and Dicot root, stem, leaf, Anther, Female, Gametophyte, egg- Apparatus, Pollination, Seed Dispersal, ovules, Placentation.

Learning Resources

Text Books, Reference Books, Other resources

Suggested Readings:

- Johri B. M Experiment Embryology of Vascular Plants, Springer- Verlag Berlin Heidelberg New York (1982)

Subject- Zoology
Course Title: Physiology and Biochemistry
UPHYSZO203

Unit: I (No. of Lectures: 12)

1. Introduction to Chordates

1.1 Traditional Knowledge on Animal Science in ancient Indian Civilization

1. 2Origin of Chordates, General characteristics and outline classification of Phylum Chordata up to orders according to Parker and Haswell, Seventh Edition

2. Protochordata

2.1 General characteristics and classification of Sub- Phylum Urochordata and Cephalochordate.

2.2 Type study of Herd mania and retrogressive metamorphosis in ascidianTadpole.

2.3 Type study of Amphioxus and its Affinities.

3. Agnatha

3.1 Comparison of Petromyzon and Myxine.

3.2 Chordata, Herd mania, Amphioxus, Cephalochordate

Unit: II (No. of Lectures: 12)

1. Pisces

1.1 General characteristics and classification of Pisces.

1.2 Accessory respiratory organs, Parental care in fishes.

2. Amphibia

2.1 General characteristics and classification of Amphibia.

2.2 Parental Care in Amphibia and Paedomorphosis

3. Reptilia

3.1. General Characteristics and classification of Reptilia.

3.2. Difference between Poisonous and Non Poisonous snakes, Venom andAntivenom

3.3. Poison apparatus and biting mechanism in snake.

Keywords/Tags: Pisces, Parental care, Amphibia, Reptiles, and Poison apparatus.

Unit: III (No. of Lectures: 12)

1. Ayes

1.1 Brief Introduction of "Birdman" of India — Dr. Salim Ali

1.2 General characteristics and classification of Ayes.

1.3 Migration of birds, principles and aerodynamics of flight.

1.4 Flight adaptation in birds.

2. Mammalia

2.1 General characteristics and classification of mammals.

2.2 Adaptive radiation in mammals with reference to locomotory appendages.

2.3 Introduction of ZSI (Zoological Survey of India)

Keywords/Tags: Ayes, Aerodynamics, Flight Adaptation, Mammalia, Adaptive Radiation, Locomotory Appendages.

Unit: IV (No. of Lectures: 12)

Comparative Anatomy of Vertebrates

Comparative study of integument and its derivatives of Vertebrates.

Comparative study of appendicular skeleton (Limb and girdles) of Vertebrates.

Comparative study of digestive system of Vertebrates.

Comparative study of respiratory system of Vertebrates
Keywords/Tags: Integument, Derivatives, Girdles, Digestive System, Respiratory System
Unit: V (No. of Lectures: 12)
Comparative Anatomy of Vertebrates.
Comparative study of aortic arches and heart of Vertebrates..
Comparative study of Brain of Vertebrates..
Comparative study of Urinogenital System of Vertebrates Study of Eye and Ear of mammals
Keywords/Tags: Heart, Brain, Kidney, Urinogenital System, Eye, Ear.

Learning Resources
Text Books, Reference Books, Other resources
Suggested Readings:

- Dhami, P.S., and Dhami, J.K. "Chordate Zoology" R.Chand & Co.(2006)
- Young J.Z. "The Life of Vertebrates. III Edition", Oxford University Press. (2004)
- Parker T.J. & Haswell, W.A., "Textbook of Zoology- Vertebrates", VII Edition, Volume II. (1972)
- Hyman, L.H. "Hyman's Comparative Vertebrate Anatomy" Third Edition, Univ. of Chicago Press , Chicago & London
- Kent, G.C., Cart R.K., "Comparative Anatomy of the Vertebrates" 9th Edition, McGraw Hill, Boston, USA. (2015).
- Jordan and Verma; "Chordate Zoology". Revised & enlarged edition, S. Chand & Co. (1965)
- Jordan E.L., " Chordate Zoology" S. Chand & Co., New Delhi (2009 reprint),
- Kotpal, R.L. " Modern Textbook of Zoology- Vertebrates", Rastogi Publications, Meerut (2000)
- Tortara, G.J. 8 Derrickson, B.H. "Principles of Anatomy & Physiology", Global Edition, John Willey & Sons, In. (2017)
- Kotpal, R.L. "Chordate and Comparative Anatomy" Edition-I, Rastogi Publications, Meerut (2017).
- Sinha A.K.,Adhikari S.,Ganguly B.B "Biology of Animals" Vol. II , New Central Book Agency, Calcutta (2012).
- Deoras, P.J., "Snakes of India" National Book Trust of India, (1981)
- Kotpal, R.L, Shastri. Shukla. "Comparative Anatomy and Developmental Biology", Edition-I, Rastogi Publications, Meerut (2019).
- Baneijee, Ananda. "Common Birds of the Indian Subcontinent" A field Guide, II Edition, Rupa & Co., New Delhi (2008).
- Ali, Salim., " The Book of Indian Birds", 12th Edition, Bombay Natural History Society, Mumbai (1968)
- Kulshreshtha, S.K., "Comparative Anatomy of Vertebrates", II revised Edition, Anmol Publications Pvt. Ltd, New Delhi, 2004.

Zoology Lab IV
UZOOLZO204

Unit: I (No. of Lectures: 6)

- Study of museum specimens
- Protochordata: Herdmania, Amphioxus
- Fishes: Scoliodon, Stegostoma, Torpedo, Heteropneustes, labeo, Exocoetus, Hippocampus, Anabas, Eel, Flat fish.
- Amphibia: Necturus, Bufo, Rana, Salamander, Hyla, Axoloti larva, mid wife Toad, Ichthyophis
- Reptilia: Chelone, Trionyx, Hemidactylus, Varanus, Chameleon, Draco, Viper, Naja, Hydrophis.
- Aves: Local Birds, Vulture, Great Indian Bustard, Lesser Florican
- Mammalia: Bat, Funambulus, Platypus, Rat.

Unit: II (No. of Lectures: 2)

- Study of Histological slides-
- T.S. of Duodenum, Stomach, Small Intestine, Liver, Pancreas, Testis, Ovary, V.S. of skin, L.S. of Kidney of vertebrates.

Unit: III (No. of Lectures: 3)

Osteology-
Study of Limb Bone and Girdles of Vertebrates (Amphibia, Reptilia, Aves, Mammalia).

Unit: IV (No. of Lectures: 2)

Study of different types of feathers/ beaks of birds.

Unit: V (No. of Lectures: 8)

Dissection of Local fish (Only demonstration of commercially available local fish/ through computer simulation method/ through you tube videos/ through models and charts.
General viscera, arterial system
Cranial nerves V, VII, IX and X

Unit: VI (No. of Lectures:2)

Mounting of scales of fishes

Unit: VII (No. of Lectures: 2)

Comparative study of heart and brain of vertebrates

Unit: VIII (No. of Lectures: 3)

Study of local bird fauna of surrounding area (College campus/ village/Garden/Ward)

Unit: IX (No. of Lectures: 2)

Collection

Keywords/Tags: Protochordata, Duodenum, Girdles, Feathers, Cranial nerves, Brain, Birds.

Learning Resources
Text Books, Reference Books, Other resources
Suggested Readings:

- Lal, S.S., "Vertebrate Practical Zoology", 11 revised edition, Rastogi publications, Meerut (2009).
- Verma P.S., "Manual of Practical Zoology- Chordates", S.Chand Co. Ltd. 11th Edition (2010).

- Prakash, M., & Arora, C.K., "Laboratory animals", Anmol Publications, New Delhi (1998).
- Yadav & Varshney, "Practical Zoology", Kedarnath Ramnath (2015)

Subject- Biochemistry
Course Title: Intermediary Metabolism
UINTEBC203

Unit: I (No. of Lectures: 20)

THERMODYNAMICS AND. CARBOHYDRATE METABOLISM:

Introduction, general features of metabolism and its importance. Principles of thermodynamics, free energy, standard free energy.- Biological oxidation reduction reactions, redox potential, ATP and high energy phosphate compounds. Carbohydrate metabolism: Reactions and energetics of Glycolysis and Tricarboxylic acid cycle (TCA), substrate level phosphorylation. Regulation of Glycolysis and TCA cycle.Alcoholic and lactic acid, Fermentation.

Reaction and significance of Gluconeogenesis, Glycogenesis, Glycogenolysis, Pentose Phosphate Pathway.

Keywords: Thermodynamics, redox reaction, ATP, fermentation, Tricarboxylic acid cycle.

Unit: II (No. of Lectures: 16)

ELECTRON TRANSPORT CHAIN AND OXIDATIVE PHOSPHORYLATION:

Structure of mitochondria, electron transport chain (ETC) and its sequence, Site of ATP production in ETC, inhibitors of ETC. Hypothesis of mitochondrial oxidative phosphorylation, inhibitors and uncouples of oxidative phosphorylation. Transport of reducing potential in Mitochondria.

Keywords: Electron transport chain, inhibitors, uncouplers, oxidative phosphorylation

Unit: III (No. of Lectures: 18)

LIPID METABOLISM:

Introduction, hydrolysis of triacylglycerol.

Transport of fatty acid in mitochondria, 13-oxidation of saturated fatty acids, ATP production from fatty acids oxidation:

Biosynthesis of saturated and unsaturated fatty acids. '

Metabolism of ketone bodies, oxidation of unsaturated and odd chain

Fatty acids- Outlines of - biosynthesis of triglycerides and important phospholipids; glycolipids, sphingo lipids; and cholesterol.Regulation of cholesterol metabolism.

Key words: -Fatty acids, triacylglycerol, 13-oxidation, ketone bodies, cholesterol.

Unit: IV (No. of Lectures: 18)

AMINO ACID METABOLISM:

General reactions of amino acid metabolism: Transamination, oxidative deamination, decarboxylation.

Outline of degradation and biosynthesis of amino acids (Glycint,

Serine,

• Methibnine, Glutamic acid, Aspartic acid, Arginine, Tyrosine, Proline).

Glycogenic and ketogenic amino acids, Urea cycle.

Key words: Transamination, deamination, glycogenic amino acids, Ketogenic amino acids.

Unit: V (No. of Lectures: 18)

NUCLEOTIDE AND PORPHYRIN METABOLISM:

Sources of atoms in purine and pyrimidine molecules.

Biosynthesis and degradation of purities and pyrimidine:
Regulation of purine and pyrimidine biosynthesis. .
Porphyrin metabolism: Biosynthesis and degradation of Porphyrin.
Production of bile pigments.
Key words: Purine metabolism, pyrimidine metabolism, porphyries
Metabolism, bile pigment synthesis.

Learning Resources
Text Books, Reference Books, Other resources
Suggested Readings:

- Nelson D. 4, Michael-M. Cox,"Lehninger Principles of Biochemistry", International Edition, CBS publishers, 2004, 4th Ed. .
- Beig J.M., Tymoczko J.L., Stryer L."Biochemistry", W.H. Freeman,1995, 4th Ed.
- Murray R.K., -Granner DK., Mayes P.A. , Rodwell V.W.,"Harper's Biochemistry", Prentice Hall International Inc., 2009, 28th Ed. .
- Geoffrey L. Zubay, "Biochemistry", McGraw Hill. 1997.
- West R., Todd, B., Mason M., BruggenR.V."Textbook of Biochemistry" Amerind Publishing Co. Pvt. Ltd., 1986, 4th Ed.
- Satyanarayana U., ChakrapaniU. “Biochemistry", Elsevier, 2013, 4th edition.
- Voet, Donald, Voet, Judith &Pratt, Charlotte, “Biochemistry", Wiley& Sons, Inc. (New Jersey), 2013, 4th Ed. .
- Chatterjea M.N. and Shinde R.,"Textbook of Medical Biochemistry, Jaypee Publications, 2012, 8th Ed.
- Books published by M.P. Hindi Granth Academy, Bhopal

Biochemistry Lab IV
UBIOCBC204

Subject- Microbiology
Course Title: Microbial Diversity and Growth
UMICRMB203

Unit: I (No. of Lectures: 15)

Virology

1.1 Discovery of viruses, general properties, concept of viroid's, virusoids, satellite viruses and Prions. Concept of Theories of viral origin- Progressive, Regressive and The Virus-first theory.Structure of Viruses. Salient features of viral nucleic acid and the presence of unusual bases.

Influenza and Hepatitis B virus, HIV, Polio virus, Vaccinia virus, Rabies Virus. TMV, Cauliflower Mosaic Virus, Bacteriophage

1.2 Viral taxonomy: Classification and nomenclature of different groups of viruses. Baltimore system of classification.

1.3 Modes of viral transmission: Persistent, non- persistent,

1.4 Replication: Assembly, maturation and release of viruses in Lytic and lysogenic cycles.

Key words- virus, classification of virus, replication of virus, Viral Diseases

Unit: II (No. of Lectures: 15)

Archaebacteria and Eubacteria

2.1 General characteristics. Phylogenetic overview of Archaebacteria.Differences between Eubacteria and Archaebactria.Classification of Bacteria - Outline of Bergey's Manual of Systematic Bacteriology.

General accounts of Mycoplasma, Actinomycetes, Rickettsia, Chlamydia and Cyanobacteria.Nutritional requirements in bacteria and nutritional categories.

2.2 Bacterial Growth- Logarithmic representation of bacterial populations, phases of growth, calculation of generation time and specific growth rate. Techniques of Measurement of bacterial growth, Factors affecting Bacterial growth.

Key words- Archaebacteria, Bergey's manual, Bacterial Growth

Unit: III (No. of Lectures: 15)

Mycology

3.1 Fungi: Characteristics and classification. Cellular structure and thallus organization of fungi.

3.2 Classes of Fungi: General features, structure, nutrition and reproduction of different fungi groups - Phycomycetes, Ascomycetes, Basidiomycetes and Deuteromycetes.

3.3 Type study of: Phytophthora, Morchella, Claviceps and Cercospora.

3.4 Diversity of fungi - Nutritional, Physiological and Ecological Diversity.

Key words- Phycomycetes, Ascomycetes, Basidiomycetes, Deuteromycetes

Unit: IV (No. of Lectures: 15)

Phycology and Protozoa

4.1 Algae-General characteristics of Algae. Occurrence, thallus organization, algal cell ultra-structure, pigments, food reserves; Vegetative, asexual and sexual reproduction.Outline of Classification of algae with emphasis on Phytoplankton.

4.2 Type study of: Chlorella, Pinnularia and Navicula.

4.2 Lichens- General Account

4.3 Protozoa- General characteristics, classification and economic importance of Protozoa.

Keywords: Algae, phytoplankton, Lichens, Protozoa

Learning Resources
Text Books, Reference Books, Other resources
Suggested Readings:

- Mehrotra, R.S. and Aneja, K.R., "An Introduction to Mycology". New Age Press, New Delhi.
- Kumar, H.D and H.N. Singh, "A Textbook on Algae" (Macmillan international college edition) 1979
- Pelczar M., Chan E.C.S. and Krieg, N.R. "Microbiology". Tata Mc Graw Hill Publishing Co. Ltd., New Delhi.
- Prescott, M.J., Harley, J.P.andKlein, D.A., "Microbiology". 5th Edition WCB Mc GrawHill, New York, (2002).
- Dubey, R.C. and Maheshwari, D.K, D.K., "A Textbook of Microbiology". S. Chand & Company Ltd., New Delhi. (2008).
- Sharma, P.D.,"Microbiology". Rastogi Publications, Meerut. (2014).
- Aneja, K.R., "Laboratory Manual of Microbiology and Biotechnology". 2nd edition. Meditech Scientific International. (2018).
- Patel, Rakesh J. and Patel, Kiran, R., "Experimental Microbiology Vol. I and Vol. II". Aditya Prakashan. (2009).

Microbiology Lab IV
UMICRMB204

- Gram staining
- Acid fast staining
- Isolation of bacteria from soil, water and air.
- Isolation of fungi from soil, water and air.
- Isolation of algae from water.
- Identification of common bacteria, fungi and Phytoplankton.
- Study of common algae and fungi through permanent slides and specimen.
- Study of common protozoan through permanent slides.
- Any other practical (s) based on theory paper.
- Note: Each practical of 2 hours will be continued for 2-3 days.

Learning Resources
Text Books, Reference Books, Other resources
Suggested Readings:

- Aneja, K.R., “Laboratory Manual of Microbiology and Biotechnology”. 2nd edition, Meditech Scientific International. (2018).
- Patel, Rakesh J. and Patel, Kiran, R., “Experimental Microbiology Vol. I and Vol. II, Aditya Prakashan. (2009).

- Dubey, R.C. and Maheshwari, D.K., Practical Microbiology". S. Chand & Co. Ltd., New Delhi, (2002).
- Gopal Reddy, M., Reddy, M.N., Saigopal, D.V.R. and Mallaiah K.V., "Laboratory Experiments in Microbiology". Himalaya Publishing House, Mumbai. (2007).

Subject- Biotechnology
Course Title: Recombinant DNA Technology
URECOBT203

Unit: I (No. of Lectures: 12)
The Basic Principles of Gene Cloning and DNA Analysis:-
Introduction, History, The advent and importance of gene cloning and the polymerase chain reaction, Purification of DNA from Living Cells, Manipulation of Purified DNA, Introduction of DNA into Living Cells, Plasmids,

Unit: II(No. of Lectures: 12)
Vectors for Cloning:-
Cloning Vectors: PBR 322, Bacteriophage, Cosmid, Phagemid, Shuttle vectors
Cloning Vectors for E. coli, λ and other high capacity vectors, Cloning Vectors for Eukaryotes, Genomics & cDNA Libraries

Unit: III (No. of Lectures: 12)
Enzymology of genetic manipulation:-
Enzymes useful in molecular cloning: Restriction endonuclease, DNA ligases, polynucleotide kinase, klenow enzyme, DNA Polymerase- I, reverse transcriptase, alkaline phosphatase, terminal nucleotidyl transferase

Unit: IV (No. of Lectures: 12)
Gene editing:-
Gene Recombination and Gene transfer: Bacterial Conjugation, Transformation, Transduction,
Gene transfer techniques: Approaches, gene silencing, Mutagenesis: random, site directed, Knock-in, Knock-out

Unit: V (No. of Lectures: 12)
Applications and Techniques of Gene Cloning:-
Polymerase Chain Reaction and qPCR, Labeling nucleic acids and blotting techniques (Southern, Northern, Western, Zooblot), DNA Sequencing, DNA Fingerprinting, Applications of recombinant DNA technologies- Agriculture, Medicine,health

Learning Resources
Text Books, Reference Books, Other resources
Suggested Readings:

- Text Book of Biotechnology - By H.K. Das (Wiley Publications)
- Test Book of Molecular Biology - By K.S. Sastry, G. Padmanabhan& C. Subramanyan, Publ: Macmillan India
- Genes - By B. Lewin - Oxford Univ. Press
- Molecular Biology & Biotechnol. - By H.D. Kumar, Publ: Vikas
- Molecular Biology - By D. Freifelder, Publ: Narosa
- Gene, Genomics and Genetic Engineering - By Irfan Ali Khan and Atiya Khanum (Ukaaz Publications)

- Advanced Biotechnology- R. C.DubeyBooks published by M.P. Hindi Granth Academy, Bhopal
- Books published by M.P. Hindi Granth Academy, Bhopal

Biotechnology Lab IV
UBIOTBT204

- Isolation of DNA from bacterial/ plant/ animal cells
- Demonstration of Polymerase Chain Reaction
- Bacterial Transformation (Selection of Trans formants with blue white selection).
- Demonstration of southern blotting.
- Demonstration of Restriction digestion of DNA.
- Demonstration of conjugation.
- Demonstration of Transduction.

Learning Resources
Text Books, Reference Books, Other resources
Suggested Readings:

- Molecular Biology and Biotechnology- By H.D. Kumar, Vikas Publication.
- Gene, Genomics and Genetic Engineering- By Irfan Khan and Atiya Khanum, Ukaaz Publication.
- Advanced Biotechnology- By R. C. Dubey
- Introductory Practical Biochemistry - By Sawheny and Singh, Narosa Publication.
- Biochemistry A lab manual- By Farrell and Taylor, Cenage Learning.
- Laboratory manual on Biotechnology- By Swamy, Rastogi Publication.
- Practical Microbiology- By Dubey and Maheshwari, S. Chand and Co.
- Trends in Molecular Biology and Biotechnology, - By Srivastava, Srivastava and Tiwari, CBS Publication, Dehradun.
- Books published by M.P. Hindi Granth Academy, Bhopal

Subject- Food technology
Course Title: Food Microbiology
UFOODFT203

Unit: I (No. of Lectures: 15)
Introduction to Food Microbiology:
History, Development and scope of Food Microbiology
Type of microorganisms associated with food- Bacteria, Mould, Fungi, Yeast and virus their morphology and cultural characteristics in brief.
Intrinsic and Extrinsic factors affecting growth of microorganisms in food.
Bacterial growth curve and microbial growth in food.
Keywords: Microbes, Yeast, Bacteria, Microbial growth curve

Unit: II (No. of Lectures: 15)
Microbial Food Spoilage, Food Borne Diseases and Microbial Safety
Food Spoilage and Food Borne Diseases: Definition and Major Causes of Food spoilage
Spoilage of specific food groups- milk and dairy products, meat, poultry and sea food, cereals and cereal products, fruit and vegetables and canned products.
Bacterial Food borne Diseases caused by Clostridium perfinges, Clostridium botulinum, Vibrio Cholera and E.coli.
Fungal Diseases caused by Alternaria, Aspergillus, Candida, and Fusarium sps.
Keywords: Food spoilage, Bacterial Food borne Diseases, Fungal Food borne Diseases.

Unit: III (No. of Lectures: 10)
Introduction to Microscopy
Organization of Food Microbiology laboratory- Instruments and devices- Importance and significance.
Role, Principle and components of simple and compound microscopes in food Microbiology
Phase contrast microscopy- Principle, applications
Electron microscopy- Types, Principles involved and applications
Keywords: Compound microscope, Phase contrast microscope, Electron microscope

Unit: IV (No. of Lectures: 10)
Introduction to Food Safety:
Importance of food safety and Fundamental Principle of Food Safety and Food Hygiene.
Food safety and Standards Regulations- Outlines
Food safety Indicator Organisms
HACCP System- Principles
Keywords: Food Sanitation and Hygiene, Food Safety, Indicator, HACCP

Unit: V (No. of Lectures: 10)
Food Fermentation
Use of Microbe in food fermentation
Types of Fermented Foods
Health Benefits of Fermented Foods
Introduction to Genetically Modified Foods (GMF): Basic Knowledge of Genetically Modified Foods

Keywords: Fermentation Fermented Dairy Products, Probiotics, and Health Benefits.

Learning Resources
Text Books, Reference Books, Other resources
Suggested Readings:

- Basic of Food Microbiology, G.J. Banwart, CBS Publishers Pvt. Ltd. India, 2004, 2nd Edition
- Food Microbiology, Adams M, Moss M., RCS Publication, 2007, 2nd Edition
- Food Microbiology, Frazier W.C. and Westhoff, D.C., McGraw Hill (India) New Delhi , 1988, Edition 4th.
- Fundamental Food Microbiology, Ray B., Bhunia A.CRC Press, 5th Edition.
- Microbiology, Pelezar MJ, Chan E.C.S and Krleg, Mc Graw Hill Education Pvt. Ltd. (India) New Delhi N.R. 5th Ed., 1998
- Modern Food microbiology James J. M, Loessner M.J, Golden D.A., CBS Publication, New Delhi, 2000 Edition 7.

Food technology Lab IV
UFOODFT204

Unit: Basic Food Microbial techniques, Microbial Safety and Quality Assessment of Foods (No. of Lectures 30)

- Cleaning and sterilization of glassware/ Plastic ware
- Preparation and sterilization of nutrient media, broth for growth study of bacteria and Fungi.
- Handling and maintenance of microscopes
- Preparation of slants, stab and plates using nutrient agar
- Morphological examination of food spoiling bacteria and fungi using permanent slides.
- Simple staining of microbes.
- Gram's staining of microbes
- Enumeration of microbes by standard plate count method
- Microbial analysis of raw foods, vegetables, fruits etc.
- Microbial analysis of spices and canned foods.
- Microbial analysis of processed and cooked foods.
- Yeast and mold count in foods.
- Microbiological testing of milk and milk products.
- Safety measures- Interactive demonstration

Keywords: sterilization, Gram's staining bacteriological analysis, nutrients, Microscope, MBRT test.

Learning Resources
Text Books, Reference Books, Other resources
Suggested Readings:

- Basic of food Microbiology, G.J. Banwart, CBS Publishers Pvt. Ltd. India, 2004, 2nd Edition.
- Food Microbiology, Adams M, Moss M., RCS Publication, 2007, 2nd Edition
- Food Microbiology, Frazier W.C. and Westhoff , D.C., McGraw Hill (India) New Delhi, 1988, Edition 4th

- Fundamental Food Microbiology, Ray B., Bhunia, A, CRC Press, 5th Edition.
- Microbiology, Pelczar MJ, Chan E.C.S and Krieg, McGraw Hill Education Pvt. Ltd. (India) New Delhi N.R. 5th Ed., 1998
- Modern Food Microbiology James J. M, Loessner M.J, Golden D.A, CBS Publication, New Delhi, 2000 Edition 7.