VIVEKANANDA GLOBAL UNIVERSITY

Programme Project Report

Bachelor of Science (Combination of three Subjects) (ODL Mode)

Table of Contents

For Vivekananda Global University, Jaipur

Registrar

Centre for Distance and Online Education-VGU

Arvind Kumar Singh

Director

1 Programmes Mission and Objectives

Vivekananda Global University (VGU), Jaipur, established in 2012, is one of Rajasthan's leading private universities, known for its commitment to academic excellence and innovation. The university is accredited with an A+ grade by the National Assessment and Accreditation Council (NAAC), achieving a CGPA of 3.29 on a 4-point scale—placing it among India's top higher education institutions.

VGU offers a diverse range of career-focused undergraduate, postgraduate, and doctoral programmes across 20+ disciplines, including Engineering, Architecture, Design, Basic & Applied Sciences, Management, Commerce, Law, Agriculture, Journalism & Mass Communication, Humanities & Social Sciences, and Pharmacy.

Inspired by the ideals of Swami Vivekananda, the university promotes intellectual growth, critical thinking, and innovation. It is widely recognized for excellence in technical education, research, entrepreneurship, and industry collaboration.

The campus is equipped with modern infrastructure, including advanced laboratories, smart classrooms, state-of-the-art studios, an IT-enabled library, and sustainable facilities such as solar and biogas plants. VGU hosts a vibrant academic community of over 4,000 students from 33 Indian states/UTs and 23 countries, supported by more than 300 experienced faculty members.

The university has received multiple accolades, including recognition from the Ministry of Education, ranking in the Band 6–25 among private institutions in India and securing the No. 1 position in Rajasthan under ARIIA. It has also been honored by ASSOCHAM as "University of the Year – West." Additionally, its innovation ecosystem has been strengthened through funding support from organizations like NITI Aayog, Ministry of MSME, and SIDBI.

The B.Sc. (Combination of Three Subjects) Programme at VGU is designed to deliver holistic and multidisciplinary scientific education. The programme emphasizes the integration of academic knowledge with practical application, ensuring students are well-prepared for industry, research, and entrepreneurial pursuits. With a strong focus on experiential learning and industry interface, the programme nurtures students' intellectual, emotional, and professional growth. It aims to build a strong foundation in scientific principles while encouraging innovation, adaptability, and lifelong learning.

Programme Objectives

1. Critical Thinking and Scientific Analysis: Develop the ability to apply scientific knowledge to analyze complex problems and build global-level competencies.

2. Problem Identification and Investigation: Equip students to identify, formulate, and solve scientific problems using analytical and research-driven approaches.

3. Mathematical and Analytical Skills: Strengthen quantitative reasoning and mathematical problem-solving abilities essential for academic and professional success.

4. Research Orientation: Provide exposure to emerging trends and developments in science and mathematics, encouraging research and innovation.

5. Interdisciplinary Approach: Promote integration of concepts from multiple scientific disciplines to address real-world challenges effectively.

6. Practical Skills and Competence: Enhance hands-on skills and practical knowledge applicable across diverse professional environments.

2 Relevance of the Program with Vivekananda Global University, Jaipur Mission and Goals

Vision

To develop an institution with a commitment to excellence in education, research and consultancy and we will nurture and promote human advancement. Our goal is to make the university a preferred institute for young women and men who are aspiring for productive careers. We want to develop them as professionals of global standard.

Mission

To promote quality education, training, research, consultancy, and enhance employability and entrepreneurial skills of our students. To integrate industry with academics in order to prepare our students in an immersive way for the world of work developing an effective interface with the industry and other institutes within and outside the country is the cornerstone of our approach. To meet these ends, we encourage and nurture the development of students' physical, mental, emotional, secular, and spiritual faculties.

B.Sc. (Combination of three subjects) Programme in ODL Mode will be closely aligned with the Vision and Mission of the University, in vowing to mentor students' physical, mental, emotional, secular and spiritual attributes to become a valued human resource. As per NEP 2020, the curriculum and syllabus have been designed at par with the conventional mode for better flexibility to learners.

3 Nature of prospective target group of learners

The learners in ODL mode are basically employed with Public / Private sectors, overaged learners for conventional mode, home-makers and learners who couldn't complete with the conventional education system for enhancement of qualification.

The target group of learners will be those students who are deprived of admission in the regular mode due to limited intake capacity, dropouts primarily due to social, financial, and economic compulsions as well as demographic reasons, population of any age and those living in remote areas where higher education institutes are not easily accessible. Delivery through ODL and online mode also contributes towards Gross Enrolment Ratio (GER) of 50% by 2035, as envisaged by the Government of India.

4 Appropriateness of programme to be conducted in Open and Distance Learning mode to acquire specific skills and competence

The B.Sc. (Combination of three subjects) programme is suitably designed for delivery through the Open and Distance Learning (ODL) mode in alignment with the guidelines of the University Grants Commission and the Distance Education Bureau (DEB).

The programme structure ensures that learners acquire adequate theoretical knowledge, analytical ability, and domain-specific competencies through a well-defined system of Self Learning Material (SLM), multimedia resources, academic counseling, and continuous evaluation. The ODL mode facilitates flexibility, accessibility, and inclusivity while maintaining academic rigor and quality standards equivalent to conventional programmes.

The programme enables learners to achieve the following outcomes:

- **Self-Directed and Lifelong Learning Skills:** Develop the ability to engage in independent learning, supported by structured SLMs, enabling learners to explore new domains and upgrade their knowledge continuously.
- **Comprehensive Domain Knowledge:** Attain a strong conceptual understanding of core disciplines, including Physical Sciences (Physics and Chemistry), Mathematical Sciences, Life Sciences (Botany and Zoology), and Information Technology, in accordance with prescribed curriculum standards.
- **Analytical and Problem-Solving Competence:** Acquire proficiency in mathematical reasoning, scientific analysis, and computational techniques, including the application of numerical methods and IT tools for problem-solving.

- **Understanding of Scientific Research Methodology:** Develop awareness of research principles, methodologies, and ethical practices, and their applications across interdisciplinary domains such as engineering, environmental science, healthcare, and emerging technologies.
- **Interdisciplinary and Applied Orientation:** Integrate knowledge from multiple scientific disciplines to address real-world problems, fostering critical thinking and innovation.
- **Practical and Skill-Based Competencies:** Gain practical exposure through virtual labs, simulations, project work, and assignments as per ODL norms, enabling application of scientific knowledge in professional and industrial contexts.
- **Employability and Professional Readiness:** Enhance skills relevant to employment in industry, research organizations, academia, and allied sectors, in line with national skill development and employability objectives.

The programme delivery is supported by a robust learner support system, including academic counselling sessions, Self learning material, digital learning platforms, and continuous internal assessment mechanisms, ensuring effective learning outcomes in conformity with UGC (ODL) Regulations.

5 Instructional Design

The B.Sc. (Combination of Subjects) Programme has been duly approved by the statutory bodies of the University in accordance with established academic regulations and governance frameworks. The University follows a systematic and periodic curriculum review mechanism to ensure that the programme remains relevant, contemporary, and aligned with advancements in scientific knowledge and industry practices.

The curriculum and syllabus of the programme are reviewed and revised once every three years to incorporate emerging trends, technological developments, and evolving academic requirements. This process ensures that learners receive high-quality education and meaningful learning experiences in line with national standards and expectations.

The revision process is initiated through structured curriculum and syllabus revision workshops, typically conducted at least six months prior to the scheduled revision cycle. These workshops involve active participation from academic faculty, subject experts across disciplines (Physics, Chemistry, Mathematics, Botany, Zoology, and Information Technology), and industry representatives, ensuring a comprehensive and multidisciplinary approach.

Proposed changes and recommendations emerging from these workshops are subsequently reviewed and validated by the respective Board of Studies of the concerned departments for academic scrutiny and final approval, as per the University's statutory procedures.

As part of the curriculum design and revision framework, the following key aspects are systematically addressed:

- Assessment and analysis of societal and industry needs
- Translation of identified needs into programme and course objectives
- Formulation of specific learning objectives and outcomes
- Structuring and grouping of objectives into relevant subject domains
- Development of course content aligned with disciplinary frameworks
- Definition of measurable learning outcomes (enabling objectives)
- Logical organization and unitization of subject matter
- Allocation of appropriate instructional time and academic weightage

This structured and outcome-based approach ensures that the programme remains academically rigorous, skill-oriented, and aligned with the guidelines of the University Grants Commission and other relevant regulatory bodies.

5.1 Curriculum Design

The University appointed highly competent academicians and experts to design the Curriculum and syllabus of the Program. Courses are designed in an impressive, effective and balanced manner, to enrich the students academically with a sequenced skills and knowledge base.

5.2 Programme structure and detailed syllabus

Name of Programme	**Bachelor of Science (Combination of three Subjects)**
Programme Outcome (Pos)	**PO1-** Knowledge of Science: Apply the knowledge of science, mathematics and fundamentals to the solution of problems with different applications thereby enabling students to be employable. **PO2-** Problem Analysis: Identify, formulate, research literature, and analyses various research and application problems reaching substantial conclusions using first principles of mathematics and natural sciences. **PO3-** Design and Development of solutions for complex problems: Design systems reactions and processes that meet the specified needs with appropriate consideration for the public health and safety and societal and environmental consideration. **PO4-** Conduct investigations of complex problems: The problems that cannot be solved by straightforward application of knowledge, theories and techniques; that may not have a unique solution which need to be defined (modeled) within appropriate mathematical framework or scientific derivation.

For Vivekananda Global University, Jaipur

Registrar

Centre for Distance and Online Education-VGU

Arvind Kumar Singh

Director

	PO5- Modern tool usage: Create, select and apply appropriate techniques, resources and modern tools along with digital and technological skills including prediction and formulization of various reactions with an understanding of the limitations. **PO6-** Environment and sustainability: Understand the impact of the scientific applications and solutions in societal and environmental contexts and demonstrate the knowledge of, and need for sustainable development. **PO7-** Ethics: Apply ethical principles and commit to professional ethics, responsibilities and norms of the scientific and holistic development. **PO8-** Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings. **PO9-** Communication: Communicate effectively on complex activities with the 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. **PO10-** Project management and finance: Demonstrate knowledge and understanding of the management principles and apply these to one's own work, as a member and leader in a team, to manage research and application projects and interdisciplinary, transdisciplinary and multidisciplinary environments. **PO11-** Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadcast context of scientific change and entrepreneurship.
Programme Specific Outcome (PSOs)	**PSO 1:** Acquire a systematic understanding of the different areas of study in physics, mathematics, Chemistry, Information Technology, Botany and Zoology. **PSO 2:** Develop skills necessary to plan, design and conduct experiments to test, demonstrate, verify and extend theoretical knowledge reliably and safely. **PSO 3:** Demonstrate generic competencies such as communicating technical concepts in popular language, skilled use of ICT and ability to work both individually and in groups. **PSO 4:** Use existing knowledge to synthesize new ideas and approaches to unfamiliar situations. **PSO 5:** Acquire ability to face competitive exams for higher study in a chosen subject and procedural knowledge required for professional engagement in industry, teaching, research or other service.
Program Education Objective (PEOs)	**PEO 1** To prepare science graduates to exhibit quality of excellence, critical thinking, creativity, inventiveness, and self-motivation for life-long learning to handle all kind of diverse situations in interdisciplinary and multidisciplinary environment. **PEO 2** To produce graduates who are globally acceptable professionals for government, corporate and research organizations along with skills for entrepreneurial pursuits in multidisciplinary areas. **PEO 3** To groom graduates who can demonstrate technical competence in the field of science and develop solutions to the complex problems. **PEO 4** To produce graduates who can ethically lead and work as a part of team towards the fulfillment of both individual and organizational goals. **PEO 5** To engage graduates in professional pursuits to enhance their own achievements along with serving the society at large.

	PEO 6 To enable the graduates to pursue higher education in sciences and allied domains.

Semester-I

	Choose any three courses (PCM/PMIT/CBZ/CBIT)			
Couse Category	**Couse Code**	**Name of the Subject**	**Credits**	
Core(Mathematics	UGMAT104	Calculus	4	12
Core(Physics)	UGPHY103	Applied Mechanics	4	
Core(Chemistry)	UGCHM102	Foundational Chemistry	4	
Core(Information Technology (IT)	UGCSA102	Introduction to Computers and Programming In C	4	
Core(Zoology)	UGZOO101	Cytology, Genetics & Infectious Diseases	4	
Core(Botany)	UGBOT102	Biodiversity of Cryptogames	4	
Core (General)	UGFUD	Fundamentals of UI/UX Design	2	9
Core (General)	UGUHV	Universal Human Values	2	
Core (General)	UGCFS	Communication for success	2	
Core (General)	UGIKS	Indian Knowledge System	3	
		Total Credits		21

Semester II

	Choose any three courses (PCM/PMIT/CBZ/CBIT)			
Couse Category	**Couse Code**	**Name of the Subject**	**Credits**	
Core(Mathematics	UGMAT112	Differential Equations	4	12
Core(Physics)	UGPHY112	Electricity and Magnetism	4	
Core(Chemistry)	UGCHM113	Bioorganic Chemistry	4	
Core(Information Technology (IT)	UGCSA112	Data Structure Using C	4	
Core(Zoology)	UGZOO111	Systematics & Animal Diversity	4	
Core(Botany)	UGBOT112	Biodiversity of Archegoniates	4	
Core (General)	UGFIC	Fundamentals of Indian Constitution	2	8
Core (General)	UGBAI	Banking and Insurance	3	
Core (General)	UGEVS	Environmental Science	3	
		Total Credits		20

For Vivekananda Global University, Jaipur

Registrar

Semester-III

	Choose any three courses (PCM/PMIT/CBZ/CBIT)			
Couse Category	**Course Code**	**Name of the Subject**	**Credits**	

Centre for Distance and Online Education-VGU

Arvind Kumar Singh

Director

Core(Mathematics	UGMAT201	Real Analysis	4	
Core(Physics)	UGPHY201	Thermal Physics and Statistical Mechanics	4	
Core(Chemistry)	UGCHM201	Industrial Organic Chemistry	4	
Core(Information Technology (IT)	UGCSA201	Database Management System	4	12
Core(Zoology)	UGZOO201	Developmental Biology of Vertebrates	4	
Core(Botany)	UGBOT201	Plant Taxonomy	4	
Core (General)	UGLGEM	Lead Generation & E-mail marketing	4	
Core (General)	UGFTE	Foundation to Entrepreneurship	2	10
Core (General)	UGNMDP	New Media & Digital Promotion	4	
		Total Credits		**22**

Semester-IV

	Choose any three courses (PCM/PMIT/CBZ/CBIT)			
Couse Category	**Couse Code**	**Name of the Subject**	**Credits**	
Core(Mathematics	UGMAT211	Algebra	4	
Core(Physics)	UGPHY211	Wave Optics	4	
Core(Chemistry)	UGCHM211	Industrial Inorganic Chemistry	4	
Core(Information Technology (IT)	UGCSA117	Object-Oriented Programming using JAVA	4	12
Core(Zoology)	UGZOO211	Molecular Biology	4	
Core(Botany)	UGBOT211	Applied Techniques In Plant Sciences	4	
Core (General)	UGMOP	Microsoft Office Practices	2	
Core (General)	UGSEM	Search Engine Marketing	4	8
Core (General)	UGBDA	Big Data Analytics	2	
		Total Credits		**20**

Semester-V

	Choose any five courses (PCM/PMIT/CBZ/CBIT)			
Couse Category	**Couse Code**	**Name of the Subject**	**Credits**	
Core(Mathematics)	UGMAT301	Linear Algebra	4	
Core(Mathematics)	UGMAT303	Numerical Analysis	4	
Core(Physics)	UGPHY301	Modern Physics	4	
Core(Physics)	UGPHY302	Nuclear and Particle Physics	4	
Core(Chemistry)	UGCHM301	Physical Chemistry	4	
Core(Chemistry)	UGCHM302	Organic Chemistry	4	
Core(Information Technology (IT)	UGCSA208	Operating System	4	20
Core(Information Technology (IT)	UGCSA301	Advanced Web Applications	4	
Core(Zoology)	UGZOO301	Chordates & Comparative Anatomy	4	
Core(Zoology)	UGZOO303	Animal Biotechnology	4	
Core(Botany)	UGBOT301	Development Biology of Plants	4	

For Vivekananda Global University, Jaipur

Registrar

Centre for Distance and Online Education-VGU

Arvind Kumar Singh

Director

Core(Botany)	UGBOT303	Genetics and Plant Breeding	4	
		Total Credits		20

Semester VI

	Choose any five courses (PCM/PMIT/CBZ/CBIT)			
Couse Category	**Couse Code**	**Name of the Subject**	**Credits**	
Core(Mathematics)	UGMAT311	Complex Analysis	4	
Core(Mathematics)	UGMAT314*	Metric Spaces	4	
Core(Physics)	UGPHY311	Electromagnetic Theory	4	
Core(Physics)	UGPHY312	Atomic and Molecular Physics	4	
Core(Chemistry)	UGCHM311	Molecular Spectroscopy	4	
Core(Chemistry)	UGCHM312	Coordination Chemistry & Radiochemistry	4	
Core(Information Technology (IT)	UGCSA212	Python Programming	4	20
Core(Information Technology (IT)	UGCSA204	Introduction to Data Science	4	
Core(Zoology)	UGZOO311	Immunology	4	
Core(Zoology)	UGZOO312	Embryology and Teratology	4	
Core(Botany)	UGBOT311	Reproductive Biology of Angiosperms	4	
Core(Botany)	UGBOT312	Gymnosperm and Paleobotany	4	
		Total Credits		20

For Vivekananda Global University, Jaipur

Registrar

Centre for Distance and Online Education-VGU

Arvind Kumar Singh

Director

Course Name: Calculus	Course Code: UGMAT104
Semester: 1	Core / Elective: Core
Teaching Scheme in Hrs (L:T:P):	Credits: 4
Type of course: Lecture+ Assignments	Total Contact Hours: 12
Continuous Internal Evaluation:	ESE:

Course Outcomes: Upon successful completion, the student will be able to
CO1: Apply techniques of partial differentiation, Euler's theorem for homogeneous functions, and the chain rule to solve multivariable calculus problems in physical and geometric contexts.
CO2: Analyze and solve optimization problems for functions of two variables using methods like Lagrange multipliers and interpret their applications through envelopes and evolutes.
CO3: Evaluate critical features of curves including concavity, inflection points, asymptotes, and curvature, and classify singularities using calculus-based techniques.
CO4: Trace and interpret curves represented in Cartesian, parametric, and polar forms, integrating modern tools and visualization techniques for effective curve analysis.
CO5: Compute areas, arc lengths, and volumes of revolution using definite integrals, including Beta and Gamma functions, and apply these to real-world modeling scenarios.

Module 1: Partial Differentiation and Multivariable Functions

Unit 1: Functions of Several Variables and Partial Derivatives
This unit introduces functions depending on two or more variables and explains the concept of partial differentiation. It focuses on computing partial derivatives with respect to one variable while keeping others constant. The unit emphasizes the interpretation and applications of partial derivatives in analyzing multivariable functions.

Unit 2: Homogeneous Functions and Euler's Theorem
This unit discusses homogeneous functions and their properties. It explains Euler's theorem for homogeneous functions and demonstrates its application in simplifying expressions involving partial derivatives. The unit highlights the importance of identifying the degree of homogeneity in functions.

Unit 3: Chain Rule and Total Differentiation
This unit covers the chain rule for functions of multiple variables and its application in composite functions. It also explains the concept of total derivative and the differentiation of implicit functions, enabling the analysis of relationships where variables are interdependent.

Module 2: Optimization and Special Curves

Unit 4: Maxima and Minima of Functions of Two Variables
This unit explains the concept of maxima and minima for functions of two variables. It includes methods for finding critical points and determining their nature using second derivative tests. The unit focuses on optimization problems in multivariable calculus.

Unit 5: Lagrange's Method of Undetermined Multipliers
This unit introduces Lagrange's method for solving constrained optimization problems. It explains how to find maxima or minima of a function subject to given constraints by introducing auxiliary variables known as Lagrange multipliers.

Unit 6: Envelopes and Evolutes
This unit discusses the concepts of envelopes and evolutes of families of curves. It explains how to determine the envelope of a given family of curves and the evolute as the locus of centers of curvature, highlighting their geometric significance.

Module 3: Curve Analysis and Properties

Unit 7: Asymptotes and Curve Behavior
This unit explains asymptotes and their role in describing the behavior of curves at infinity. It includes methods to find different types of asymptotes and their significance in curve analysis.

Unit 8: Concavity, Convexity and Points of Inflexion This unit focuses on tests for concavity and convexity of curves. It explains how to determine points of inflexion where the curvature changes sign, providing insight into the shape of curves.
Unit 9: Singularities and Curvature This unit discusses singular points and multiple points of curves, including their classification. It also introduces the concept of curvature, which measures how sharply a curve bends at a given point, and its mathematical evaluation.
Module 4: Curve Tracing in Different Coordinate Systems
Unit 10: Tracing of Curves in Cartesian Coordinates This unit explains the systematic method of tracing curves in Cartesian coordinates. It includes the study of symmetry, intercepts, asymptotes, and general behavior of curves to sketch their shapes accurately.
Unit 11: Parametric Representation of Curves This unit introduces parametric equations of curves and explains how to trace curves represented in parametric form. It focuses on eliminating parameters and analyzing the behavior of curves using parameter variation.
Unit 12: Polar Coordinates and Curve Tracing This unit discusses polar coordinates and the tracing of curves in polar form. It includes the study of standard polar curves and their properties, providing a comprehensive understanding of non-Cartesian representations.
Module 5: Special Functions and Applications of Integration
Unit 13: Beta and Gamma Functions This unit introduces Beta and Gamma functions as important special functions in mathematics. It explains their definitions, properties, and interrelation, along with their applications in evaluating integrals.
Unit 14: Rectification and Area under Curves This unit focuses on the concept of rectification, which involves finding the length of curves. It also explains methods to determine the area under curves using definite integration, highlighting practical applications.
Unit 15: Volumes and Surfaces of Solids of Revolution This unit discusses the calculation of volumes and surface areas of solids formed by revolving curves about an axis. It emphasizes the application of integration techniques in solving problems related to solids of revolution.
Practicals: Every student must perform experiments from the following list using mathematical software tools: Plotting of graphs of function log (ax + b) and e^{ax+b}. Plotting the graph of functions 1/ (ax + b) and |ax + b|. Plotting the graph of functions sin (ax + b) and cos (ax + b). Plotting the graphs of polynomial of degree up to 5, Evaluate and plot the derivatives and comparing them. Evaluate the integrals. Evaluate Surface area and volume of solid of Revolution Sketching parametric curves Circle and ellipse. Sketching parametric curves Trochoid and cycloid. Sketching parametric curves epicycloids and hypocycloid.

Suggested Books:

Thomas and Finney, (1998), Calculus and Analytic Geometry, Ninth Edition, Addison-Wesley.
Howard Anton H.A., Bivens I. and Davis S., (2001), Calculus. Seventh Edition, John Wiley and Sons.
Stewart J., (2007), Essential Calculus, Thompson Publications.
Prasad G., (2016), Differential Calculus, Nineteenth Edition.

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Registrar

Course Name: Applied Mechanics	Course Code: UGPHY103
Semester: 1	Core / Elective: Core
Teaching Scheme in Hrs (L:T:P):	Credits: 4
Type of course: Lecture+ Assignments	Total Contact Hours: 12
Continuous Internal Evaluation:	ESE:

Course Outcomes:
Upon successful completion, the student will be able
CO1: Understand and explain fundamental principles of dynamics, including inertial and non-inertial frames, conservation laws, and center of mass calculations.
CO2: Apply work-energy theorems and analyze conservative and non-conservative force systems to solve physical problems involving potential energy and collisions.
CO3: Analyze rotational motion and non-inertial reference frames by determining moments of inertia and studying effects of fictitious forces like Coriolis and centrifugal forces.
CO4: Evaluate central force motions, solve two-body problems, and examine orbital stability using effective potential and energy diagrams.
CO5: Create and interpret relativistic kinematics and dynamics scenarios using Lorentz transformations, applying concepts like time dilation and mass-energy equivalence.

Module 1: Fundamentals of Dynamics

Unit 1: Frames of Reference and Laws of Motion
This unit introduces inertial and non-inertial frames of reference and explains Newton's laws of motion along with their invariance under Galilean transformations. It establishes the foundational principles governing motion and highlights their applicability in different reference frames.

Unit 2: Momentum and Systems of Particles
This unit focuses on the concept of momentum, including systems with variable mass such as rocket motion. It explains the dynamics of a system of particles and the principle of conservation of momentum, along with the concept of impulse in analyzing motion.

Unit 3: Centre of Mass and Continuous Systems
This unit explains the determination of the centre of mass for discrete and continuous bodies, particularly those with cylindrical and spherical symmetry. It also includes differential analysis of a vertically hanging massive rope, illustrating applications of mechanics to continuous systems.

Module 2: Work, Energy and Collisions

Unit 4: Work, Energy and Forces
This unit covers work and the work-energy theorem, along with conservative and non-conservative forces such as gravitational, electrostatic, frictional, and magnetic forces. It introduces potential energy, energy diagrams, and the concept of force as the gradient of potential energy.

Unit 5: Equilibrium and Energy Considerations
This unit explains stable, unstable, and neutral equilibrium using energy diagrams. It also discusses the work done by non-conservative forces and their effect on mechanical energy.

Unit 6: Collisions and Scattering
This unit focuses on elastic and inelastic collisions and explains the kinematics of two-body scattering in both center of mass and laboratory frames. It highlights conservation laws and their applications in collision processes.

Module 3: Rotational Dynamics and Non-Inertial Systems

Unit 7: Angular Motion and Conservation Laws
This unit introduces angular momentum for particles and systems of particles, torque, and the principle

of conservation of angular momentum. It explains rotational motion about a fixed axis and its governing equations.
Unit 8: Moment of Inertia and Rotational Energy This unit covers the determination of moment of inertia for symmetric rigid bodies such as rectangular, cylindrical, and spherical objects using parallel and perpendicular axes theorems. It also explains the kinetic energy of rotation and motion involving both translation and rotation.
Unit 9: Non-Inertial Frames and Fictitious Forces This unit explains non-inertial frames of reference and the concept of fictitious forces. It includes the study of uniformly rotating frames, centrifugal force, and Coriolis force along with their practical applications.
Module 4: Central Force Motion
Unit 10: Central Forces and Two-Body Problem This unit introduces central forces and explains the conservation of angular momentum in such systems. It discusses the two-body problem and its reduction to an equivalent one-body problem for simplified analysis.
Unit 11: Effective Potential and Orbital Stability This unit explains the concept of effective potential energy and uses energy diagrams to analyze the stability of orbits for central potentials of the form Kr^n for $n = 2$ and $n = -1$. It also includes discussion of trajectories for inverse-square type forces.
Unit 12: Kepler's Laws and Orbital Motion This unit focuses on the solution of Kepler's problem and explains Kepler's laws of planetary motion. It also discusses the motion of artificial satellites and the nature of orbital paths.
Module 5: Relativity
Unit 13: Foundations of Special Relativity This unit introduces the postulates of the special theory of relativity and Lorentz transformations. It explains concepts such as simultaneity, length contraction, time dilation, proper length, and proper time.
Unit 14: Relativistic Effects and Spacetime This unit covers the lifetime of relativistic particles, including examples such as muon decay. It explains space-like, time-like, and light-like separated events and their significance in spacetime physics.
Unit 15: Relativistic Dynamics This unit discusses the relativistic transformation of velocity and acceleration. It explains the variation of mass with velocity, mass-energy equivalence, and the transformation of energy and momentum in relativistic systems.
Practical's: Mandatory Activities: • Determine the least count of meter scale, vernier callipers, screw gauge and travelling microscope, use these instruments to measure the length of various objects multiple time, find the mean and report the result along with the uncertainty up to appropriate number of significant digits. Errors: (a) Types of errors in measurements (instrumental limitations, systematic errors and random errors), Accuracy and Precision of observations, significant figures. (b) Introduction to error estimation, propagation of errors and reporting of results along with uncertainties with correct number of significant figures. (c) Statistical analysis of random errors, need for making multiple observations, standard error in the mean as estimate of the error. Graph Plotting: Pictorial visualization of relation between two physical quantities, Points to be kept in mind while plotting a graph manually. Data Analysis: Principle of least square fitting (LSF) and its application in plotting linear relations. Estimation of LSF values of slope, intercept and uncertainties in slope and intercept. Every student must perform at least 4 experiments from the following list. To determine the Height of a Building using a Sextant.

To determine Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille's method).
3. To determine the Moment of Inertia of a Flywheel.
4. To determine the Young's Modulus of a Wire by Optical Lever Method.
5. To determine the Modulus of Rigidity of a Wire by Maxwell's needle.
6. To determine the Elastic Constants of a Wire by Searle's method.
7. To determine g by Bar Pendulum.
8. To determine g by Kater's Pendulum.
9. To determine g and velocity for a freely falling body using Digital Timing Technique
10. To study the Motion of a Spring and calculate (a) Spring Constant (b) Value of g.

Suggested Books:

1) An Introduction to Mechanics (2/e), Daniel Kleppner and Robert Kolenkow, 2014, Cambridge University Press.
2) Mechanics Berkeley Physics Course, Vol. 1, 2/e: Charles Kittel, et. al., 2017, McGraw Hill Education
3) University Physics, H. D. Young, R. A. Freedman, 14/e, 2015, Pearson Education.
4) Classical Mechanics, H. Goldstein, C. P. Poole, J. L. Safko, 3/e, 2002, Pearson Education.
5) Newtonian Mechanics, A.P. French, 2017, Viva Books.
6) Feynman Lectures, Vol. 1, R. P. Feynman, R. B. Leighton, M. Sands, 2008, Pearson Education.

For Vivekananda Global University, Jaipur

Registrar

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Director

Course Name: Foundational Chemistry	Course Code: UGCHM102
Semester: 1	Core / Elective: Core
Teaching Scheme in Hrs (L:T:P):	Credits: 4
Type of course: Lecture+ Assignments	Total Contact Hours: 12
Continuous Internal Evaluation:	ESE:

Course Outcomes:
CO1:Students will be able to understand the basic knowledge of atomic structure, de-Broglie's theory, Heisenberg
Uncertainty principle, Quantum numbers & their significance, stability of half filled & completely filled orbitals.
CO2:Students will be able to get the knowledge of various types of bonding like ionic bonding, Lattice energy, Fajan's
rule.
CO3;Students will be able to analyze the covalent bonding, VSEPR theory,& molecular orbital theory of Homonuclear
and Heteronuclear (CO and NO) diatomic molecules.
CO4;Students will be able to apply the knowledge of about stereoisomerism, optical isomerism & geometrical
isomerism enantiomeric and diastereomeric conditions, including conformation.
CO5:Students will be able to study the named reactions and analyze the mechanisms of various organic reactions & its
importance to perform volumetric analysis of inorganic salts and prepare organic compounds.

Module 1: Atomic Structure

Unit 1: Foundations of Atomic Theory
This unit covers the fundamental concepts of atomic structure including Bohr's theory and its limitations, along with the dual behavior of matter and radiation. It explains de Broglie's relation and the Heisenberg Uncertainty Principle, establishing the basis of quantum mechanics. The Schrödinger wave equation and its importance in describing atomic behavior are also discussed, along with an introduction to hydrogen atom spectra.

Unit 2: Quantum Mechanical Model of Atom
This unit focuses on the quantum mechanical description of atoms, including radial and angular wave functions. It explains quantum numbers and their significance in defining the state of an electron. The concept of radial probability distribution is also included to describe the likelihood of finding an electron at a particular distance from the nucleus.

Unit 3: Electronic Configuration and Stability
This unit deals with the rules for filling electrons in various orbitals based on principles such as Aufbau, Pauli Exclusion, and Hund's rule. It also explains the stability associated with half-filled and completely filled orbitals, providing insight into atomic structure and chemical behavior.

Module 2: Ionic Bonding

Unit 4: Nature of Ionic Bonding
This unit introduces the general characteristics of ionic bonding, including the formation of ions and electrostatic forces of attraction between them. It explains the concepts of lattice energy and solvation energy and their role in determining the properties and stability of ionic compounds.

Unit 5: Lattice Energy and Thermodynamic Approach
This unit covers the calculation of lattice energy using the Born-Landé equation and explains the Born-Haber cycle along with its applications. It provides a thermodynamic perspective on the formation of ionic compounds and the factors influencing their stability.

Unit 6: Polarization and Fajan's Rules This unit explains the concepts of polarizing power and polarizability and their effect on ionic character. It also discusses Fajan's rules, which help predict the degree of covalent character in ionic compounds based on size and charge considerations.
Module 3: Covalent Bonding and Molecular Orbital Theory
Unit 7: Valence Bond Theory and Hybridization This unit discusses the valence bond theory and its limitations, along with the concept of hybridization in explaining molecular geometry. It also introduces the valence shell electron pair repulsion (VSEPR) theory and applies it to molecules such as NH_3, H_3O^+, SF_4, ClF_3, ICl_2^-, and H_2O.
Unit 8: Molecular Orbital Theory This unit explains the basic concepts of molecular orbital theory, including the formation of molecular orbitals from atomic orbitals. It covers homonuclear and heteronuclear diatomic molecules such as CO and NO, highlighting bonding and antibonding interactions.
Unit 9: Comparison of Bonding Theories This unit introduces the valence bond model of the hydrogen molecule and compares it with the molecular orbital theory. It highlights the advantages and limitations of both approaches in explaining chemical bonding and molecular structure.
Module 4: Stereochemistry
Unit 10: Conformational Analysis and Representations This unit covers the conformations of organic molecules such as ethane, butane, and cyclohexane. It also explains the interconversion between different structural representations including wedge formula, Newman projection, sawhorse, and Fischer projections.
Unit 11: Chirality and Types of Isomerism This unit introduces the concept of chirality for molecules with up to two chiral carbon atoms. It explains geometrical and optical isomerism, including enantiomerism, diastereomerism, and meso compounds, along with the concepts of threo and erythro and cis-trans nomenclature.
Unit 12: Configuration and Nomenclature This unit focuses on the application of CIP rules for assigning R/S configurations in molecules with up to two chiral centers. It also explains E/Z nomenclature for compounds containing carbon-carbon double bonds.
Module 5: Mechanisms of Organic Reactions
Unit 13: Substitution Reactions This unit covers substitution reactions including SN1 and SN2 mechanisms, along with electrophilic aromatic substitution in benzene and free radical halogenation of alkanes. It explains the factors influencing these reactions and their mechanistic pathways.
Unit 14: Elimination and Addition Reactions This unit discusses elimination reactions such as those in alkyl halides and dehydration of alcohols. It also explains addition reactions, including electrophilic and free radical addition in alkenes, as well as nucleophilic addition in aldehydes and ketones.
Unit 15: Rearrangement Reactions This unit focuses on rearrangement reactions involving carbocation and free radical intermediates. It explains the mechanisms and factors that drive structural rearrangements in organic molecules.

For Vivekananda Global University, Jaipur

Registrar

Centre for Distance and Online Education-VGU

Arvind Kumar Singh

Director

Course Name: Introduction to Computers & Programming in C	Course Code: UGCSA102
Semester: 1	Core / Elective: Core
Teaching Scheme in Hrs (L:T:P):	Credits: 4
Type of course: Lecture+ Assignments	Total Contact Hours:
Continuous Internal Evaluation:	ESE:

Course Outcomes: This course will enable the students to learn:
CO1: Understand a broad perspective about the uses of computers in engineering industry.
CO2: Develop basic understanding of computers, the concept of algorithm and programming.
CO3: Develop the ability to analyze a problem, develop an algorithm to solve it.
CO4: Implement the C programming language for various algorithms.
CO5: Learn the more advanced features of the C language

Unit 1: Computer Fundamentals and Architecture
This unit introduces the basic concepts of computers and the components of a computer system, including input, output, memory, and processing units. It explains computer architecture along with the distinction between hardware and software. It also covers different types of programming languages and the roles of system software such as assembler, compiler, interpreter, linker, and loader.

Unit 2: Algorithms and Complexity
This unit explains the concept of algorithms, their definition, and essential characteristics such as finiteness, definiteness, and effectiveness. It also introduces complexity analysis and basic complexity notations used to evaluate algorithm efficiency.

Unit 3: Flowcharts and Problem Solving
This unit focuses on flowcharts, including their definition and commonly used symbols. It explains how to represent logical steps graphically and covers the development of algorithms and flowcharts for solving simple computational problems.

Unit 4: Fundamentals of C Programming
This unit introduces the C programming language, its features, and the structure of a basic C program. It explains C tokens, data types, and the rules governing variable declaration and usage.

Unit 5: Operators and Expressions
This unit covers different types of C operators, including arithmetic, relational, logical, and assignment operators, along with their precedence. It also explains type conversion and evaluation of expressions.

Unit 6: Control Structures and Looping
This unit discusses control structures such as if, if-else, nested if, and switch-case statements for decision making. It also explains looping constructs including while, do-while, and for loops, along with unconditional control statements such as break and continue.

Unit 7: Arrays and Strings
This unit explains one-dimensional and two-dimensional arrays, including their declaration, initialization, and usage. It also covers character arrays and strings, along with their manipulation in C programming.

Unit 8: Functions and Parameter Passing
This unit introduces functions, their types, and the concepts of formal and actual arguments. It explains parameter passing methods such as call by value and call by reference, along with passing arrays to functions.

Unit 9: Advanced Function Concepts
This unit focuses on nested functions and recursion, explaining how functions can call themselves and other functions to solve complex problems efficiently.

Unit 10: Storage Classes and Introduction to Structures This unit introduces different types of storage classes in C. It explains structures, their advantages, and how they allow grouping of different data types under a single name.
Unit 11: Working with Structures This unit covers accessing elements of a structure, nested structures, and arrays of structures. It also explains the use of structures with functions for efficient data handling.
Unit 12: Unions and Enumerated Data Types This unit explains unions and their memory-sharing feature, along with bit-fields. It also introduces enumerated data types and their use in defining user-specific constants.
Unit 13: Basics of Pointers This unit introduces the concept of pointers, including their definition and declaration. It explains how pointers store memory addresses and their importance in C programming.
Unit 14: Applications of Pointers This unit focuses on the use of pointers in programming, including accessing variables indirectly and enhancing efficiency in data manipulation.
Unit 15: File Handling in C This unit explains file handling operations in C, including different modes of opening a file. It covers reading from and writing to files, enabling data storage and retrieval.
List of Practical: Familiarization with programming environment. Programming for Simple computational problems using arithmetic expressions. Programming for Problems involving if-then-else structures. Programming for Iterative problems e.g. sum of series etc. Programming for one-dimensional Array manipulation. Programming for Matrix problems, String operations. Programming for Simple functions Programming for Recursive functions. Programming for Pointers and structures. Programming for File operations

Suggested Books:

1.Lee, J.D.; (2010), Concise Inorganic Chemistry, Wiley India.
2.Huheey, J.E.; Keiter, E.A.; Keiter; R. L.; Medhi, O.K. (2009), Inorganic Chemistry- Principles of Structure and Reactivity, Pearson Education.
3.Douglas, B.E.; McDaniel, D.H.; Alexander, J.J.(1994), Concepts and Models of Inorganic Chemistry,John Wiley & Sons.
4.Atkins, P.W.; Overton, T.L.; Rourke, J.P.; Weller, M.T.; Armstrong, F.A. (2010), Shriver and Atkins Inorganic Chemistry, 5th Edition, Oxford University Press.
5.Jeffery, G.H.; Bassett, J.; Mendham, J.; Denney, R.C. (1989), Vogel's Textbook of Quantitative Chemical Analysis, John Wiley and Sons.
6.Wulfsberg, G (2002), Inorganic Chemistry, Viva Books Private Limited.
7.Miessler, G.L.; Fischer P.J.; Tarr, D. A. (2014), Inorganic Chemistry, 5th Edition, Pearson.

Digital References:

Course Name: CYTOGENETICS, GENETICS & INFECTIOUS DISEASES	Course Code: UGZOO101
Semester: 1	Core / Elective: Core
Teaching Scheme in Hrs (L:T:P):	Credits: 4
Type of course: Lecture+ Assignments	Total Contact Hours: 12
Continuous Internal Evaluation:	ESE:

Course Outcomes:
Upon successful completion, the student will be able to
CO1: Understand the structure and function of cell organelles and their roles in cellular processes.
CO2: Explain the processes of cell division, including mitosis and meiosis, and their significance in growth and reproduction.
CO3: Apply Mendel's laws of inheritance to analyze genetic crosses and predict offspring traits.
CO4: Identify chromosomal aberrations and their implications in genetic disorders through pedigree analysis.
CO5: Describe the structure, life cycle, and pathogenicity of common infectious agents and their control measures.

Unit 1: Plasma Membrane and Cell Interactions
The plasma membrane is a dynamic structure composed of lipids and proteins that regulate the movement of substances in and out of the cell. Its chemical structure includes a phospholipid bilayer with embedded proteins that perform transport, signaling, and structural roles. Cell-cell interaction is essential for tissue organization and communication, primarily mediated through cell adhesion mechanisms. These interactions enable cells to recognize and bind with neighboring cells, maintaining structural integrity and facilitating signaling processes.

Unit 2: Endomembrane System and Cellular Transport
The endomembrane system is a network of membranous structures involved in protein targeting and sorting within the cell. Proteins synthesized in the cell are directed to specific locations through signal sequences. Endocytosis and exocytosis are key processes that regulate the intake and release of materials. Endocytosis allows cells to internalize substances, while exocytosis enables secretion of molecules, playing a vital role in cellular communication and transport.

Unit 3: Cytoskeleton and Cell Organelles
The cytoskeleton provides structural support and facilitates intracellular transport through components such as microtubules, microfilaments, and intermediate filaments. Mitochondria are double-membraned organelles responsible for energy production through oxidative phosphorylation. Peroxisomes are involved in metabolic processes such as detoxification, while ribosomes are the sites of protein synthesis, playing a crucial role in cellular function.

Unit 4: Nucleus and Genetic Material
The nucleus is a membrane-bound organelle that houses the genetic material in eukaryotic cells and regulates cellular activities. DNA and RNA are nucleic acids with distinct chemical structures and base compositions that store and transmit genetic information. DNA supercoiling plays a critical role in compacting genetic material, while different types of DNA and RNA perform specialized functions in replication, transcription, and translation.

Unit 5: Chromatin Organization and Chromosomes
Chromatin is a complex of DNA and proteins that organizes genetic material within the nucleus. It exists in different forms, allowing regulation of gene expression. The structure of chromosomes ensures proper distribution of genetic material during cell division. Chromatin organization and chromosome structure are essential for maintaining genetic stability and facilitating cellular processes.

Unit 6: Cell Cycle, Division, and Signaling
The cell cycle consists of a series of phases that regulate cell growth and division. Mitosis and meiosis

are the two types of cell division responsible for growth, repair, and reproduction. The regulation of the cell cycle ensures accuracy in DNA replication and division, while apoptosis is a programmed cell death mechanism maintaining cellular balance. Cell signaling involves intracellular signaling pathways, cell surface receptors, G-protein linked receptors, and the JAK-STAT pathway, which coordinate cellular responses to external stimuli.
Unit 7: Principles of Mendelism and Inheritance Mendel's laws form the foundation of heredity, explaining how traits are transmitted from one generation to another. Monohybrid and dihybrid crosses demonstrate inheritance patterns, while concepts such as complete and incomplete dominance describe variations in trait expression. Penetrance and expressivity further explain how genes are expressed in individuals.
Unit 8: Sex Determination and Sex-Linked Traits Sex determination mechanisms vary among organisms, with Drosophila and humans providing important models. Sex-linked characteristics are traits associated with sex chromosomes, and dosage compensation ensures balanced gene expression between sexes. These concepts are essential for understanding genetic differences between males and females.
Unit 9: Extensions of Mendelism and Gene Interactions Extensions of Mendelism include multiple alleles and gene interactions that influence phenotypic expression. Cytoplasmic inheritance and genetic maternal effects highlight the role of non-nuclear factors in heredity. The interaction between genes and environment further demonstrates how external conditions affect genetic expression and variation.
Unit 10: Human Karyotype and Chromosomal Structure The human karyotype represents the complete set of chromosomes, including their number and structure. Chromosomes carry genetic information essential for normal development and functioning. Understanding chromosomal structure is fundamental to studying genetic disorders.
Unit 11: Chromosomal Anomalies and Pedigree Analysis Chromosomal anomalies include structural and numerical aberrations that can lead to genetic disorders. Examples of such abnormalities help in understanding their effects on individuals. Pedigree analysis is a method used to trace inheritance patterns in families, aiding in the identification of genetic traits and disorders.
Unit 12: Patterns of Inheritance Patterns of inheritance include autosomal dominant, autosomal recessive, X-linked recessive, and X-linked dominant traits. These patterns explain how genetic traits are passed through generations and are essential for genetic counseling and disease prediction.
Unit 13: Pathogenic Organisms and Their Characteristics Pathogenic organisms include viruses, bacteria, fungi, protozoa, and worms, each with distinct structural and functional characteristics. These organisms are responsible for various infectious diseases and have diverse modes of transmission and infection.
Unit 14: Parasitic Diseases and Their Control Common parasites such as Trypanosoma, Giardia, and Wuchereria have specific life cycles and pathogenic mechanisms. These parasites cause diseases with identifiable symptoms, and their control involves preventive and therapeutic measures to reduce infection and spread.
Unit 15: Major Infectious Diseases and Prevention Infectious diseases such as tuberculosis and hepatitis have specific causes, symptoms, and diagnostic methods. Prevention strategies include vaccination, hygiene, and early detection. Understanding these diseases is crucial for effective public health management and disease control.
Practicals: 1. To check the permeability of cells using salt solution of different concentrations. 2. To study different cell types such as buccal epithelial cells, neurons, striated muscle cells using Methylene blue. 3. To prepare molecular models of nucleotides, amino acids, dipeptides using bead and stick method. 4. Study of mutant phenotypes of Drosophila. 5. Preparation of polytene chromosomes. 6. Study of sex chromatin (Barr bodies) in buccal smear and hair bud cells (Human).

7. Preparation of human karyotype and study the chromosomal aberrations with respect to number, translocation, deletion etc. from the pictures provided.
8. To prepare family pedigrees.

Books Suggested:

1. Thomas J. Kindt, Richard A. Goldsby, Barbara A. Osborne, Janis KubyKuby Immunology. W H Freeman (2007)
2. Kesar, Saroj and Vashishta N. (2007). Experimental Physiology: Comprehensive Manual. Heritage Publishers, New Delhi.

For Vivekananda Global University, Jaipur

Registrar

Centre for Distance and Online Education-VGU

Arvind Kumar Singh

Director

Course Name: BIODIVERSITY OF CRYPTOGAMES	Course Code: UGBOT102
Semester: 1	Core / Elective: Core
Teaching Scheme in Hrs (L:T:P):	Credits: 4
Type of course: Lecture+ Assignments	Total Contact Hours: 12
Continuous Internal Evaluation:	ESE:

Course Outcomes:
Upon successful completion, the student will be able
CO1: Describe classification, structure, reproduction, economic importance, and evolutionary trends in algae and bryophytes; summarize Indian contributions in Phycology and Bryology.
CO2: Apply morphological and reproductive features to illustrate algal diversity through representative genera.
CO3: Analyze life cycles and phylogenetic traits of major fungal groups up to the order level.
CO4: Evaluate lichen and mycorrhizal symbiosis based on structure, classification, and ecological roles.
CO5: Design applications of algae and fungi in biotechnology, industry, and environmental sustainability.

Unit 1: Classification Systems and Criteria
Biological classification is based on morphological, physiological, and evolutionary criteria. Systems such as Fritsch's classification and Lee's evolutionary classification (up to groups) provide frameworks for understanding diversity and relationships.

Unit 2: Structure, Function, Reproduction, and Economic Importance
Organisms exhibit diverse structural and functional adaptations. Reproduction may be vegetative, asexual, or sexual. Many groups have economic importance in agriculture, medicine, and industry.

Unit 3: Evolutionary History and Indian Contributors
The evolutionary history traces the origin and diversification of organisms. Indian scientists have made significant contributions to the fields of Phycology and Bryology through research and classification studies.

Unit 4: General Characteristics and Structure of Algae
Algae are photosynthetic organisms found in aquatic and moist environments. They show a wide range of thallus organization from unicellular to complex multicellular forms with diverse cell structures.

Unit 5: Reproduction in Algae
Algae reproduce through vegetative, asexual, and sexual methods. Examples include Chlorophyceae (Chlamydomonas, Volvox, Chara), Phaeophyceae (Ectocarpus, Fucus), Rhodophyceae (Polysiphonia), and Xanthophyceae (Vaucheria).

Unit 6: Occurrence and Diversity of Algae
Algae occur in freshwater, marine, and terrestrial habitats. They exhibit significant diversity in form, function, and ecological roles.

Unit 7: General Characteristics and Growth Patterns
Fungi are heterotrophic organisms with diverse growth and development patterns. They play important roles in decomposition and nutrient cycling.

Unit 8: Taxonomical Groups and Life Cycles
Fungi are classified into groups such as Pyrenomycetes (Clavicipitales), Discomycetes (Pezizales), Loculoascomycetes (Dothidiales), Teliomycetes, and Hymenomycetes, based on their life cycle and reproductive structures.

Unit 9: Phylogeny and Development
Fungal phylogeny explains evolutionary relationships among groups. Their development includes complex reproductive cycles and adaptations.

Unit 10: Lichens – Characteristics and Structure Lichens are symbiotic associations between algae and fungi. They show different growth forms and thallus organization and are found in diverse habitats.
Unit 11: Reproduction and Classification of Lichens Lichens reproduce through vegetative, asexual, and sexual methods. Their classification is based on fungal components and structural features.
Unit 12: Mycorrhiza and Its Significance Mycorrhiza refers to symbiotic associations between fungi and plant roots. Types include ectomycorrhiza and endomycorrhiza, which enhance nutrient absorption and plant growth.
Unit 13: Economic Importance of Algae Algae are used as sources of protein (SCP), biofertilizers, and in food, pharmaceuticals, and industries. They also play roles in environmental processes like algal blooms.
Unit 14: Ecological Role of Algae Algae such as benthic macroalgae are influenced by environmental factors and contribute to ecosystem balance and productivity.
Unit 15: Industrial Importance of Fungi Fungi are widely used in industries for the production of alcohol, organic acids, antibiotics, and enzymes, highlighting their economic and biotechnological significance.
PRACTICALS: Introduction of handling and maintenance of laboratory equipments Double staining technique and technique for preparation of permanent slides. Algae- Study of the vegetative and reproductive structures in *Nostoc, Chlamydomonas, Volvox, ,Chara, Vaucheria, , Polysiphonia* Fungi- Introduction to the world of fungi (Unicellular, coenocytic/septate mycelium, ascocarps&basidiocarps. Preparation of slides and study of following genera through temporary mounts and permanent slides: *Albugo, , Aspergillus, , Puccinia, Ustilago, Alternaria.* Lichens: Study of growth forms of lichens (crustose, foliose and fruticose) on different substrates. Study of thallus and reproductive structures (soredia and apothecium) through permanent slides. Mycorrhizae: ectomycorrhiza and endomycorrhiza (Photographs)

Suggested Books:

Kumar, HD. 1958. Introductory Phycology. Affiliated East-West Press Ltd., New Delhi.
Morris, I. 1986. An Introduction to Algae. Cambridge University Press. Cambridge, UK.
Round, FE. 1986. The Biology of Algae. Cambridge University Press, Cambridge.
Smith, GM. 1971. Cryptogamic Botany. Vol. I. Algae and Fungi. Tata McGraw Hill Publishing Co., New Delhi.
Smith, GM. 1971. Cryptogamic Botany. Vol. II. Bryophytes and Pteridophytes. Tata McGraw Hill Publishing Co., New Delhi
Alexopoulos, C.J. and C. W. Mims (1979) : Introductory Mycology

For Vivekananda Global University, Jaipur
Registrar

Centre for Distance and Online Education-VGU
Arvind Kumar Singh
Director

Course Name: Fundamentals of UI/UX Design	Course Code: UGFUD

Semester: I	Core / Elective: Core
Teaching Scheme in Hrs (L:T:P):	Credits: 2
Type of course: Lecture+ Assignments	Total Contact Hours: 6
Continuous Internal Evaluation:	ESE:
Course Outcomes: Upon successful completion, the student will be able Co1To understand the concept of UX design and how it has evolved C02 Able to understand UX design process and methodology Co3 Able to understand how UX industry work Co4 To know the job, roles and responsibilities in UX industry Co5 To understand the importance of UX in digitalization and different types of industries	
Unit 1: Evolution of UX Design ,Understand the evolution of UX design as an industry practice and learning about UX industry experts, Design around us, Job roles and responsibilities in the UX industry, UX industry trends in various sectors, Ergonomics for UX Designers	
U**nit-2** Processes and Methodologies ,Understanding UX design processes and methodologies – user centred design, ImaginXP 6D model of UX framework	
Unit 3: Tools and technology, prototype, Industry standards, Technology, NFC, Chatbot, Siri	
Unit 4- Introduction to Voice User Interface and Gesture Based Interfaces	
Unit 5: UX industry trends in various sectors.	
Unit 6- Project on UX design process and industry trends	
Reference Books:	
. 1. Designing for Digital Age: How to create human-centered products and services - Kim Goodwin 2. Sketching the User experiences - Bill Buxton 3. The design of everyday things - Don Norman 4. The elements of user experience - Jesse James Garrett	

Course Name: Indian Knowledge System	Course Code: UGIKS
Semester: I	Core / Elective: Core
Teaching Scheme in Hrs (L:T:P):	Credits: 3
Type of course: Lecture+ Assignments	Total Contact Hours:
Continuous Internal Evaluation:	ESE:
Course Outcomes: CO1: Understand the concept of Indian Knowledge System (IKS) and its significance in contemporary times. CO2: Analyze the historical context and reasons for the necessity of preserving and studying IKS. CO3: Demonstrate knowledge of the organizational structure of IKS, including its classification and components. CO4: Evaluate the historicity of IKS, considering its evolution and contributions to various fields. CO5:Identify and discuss the salient aspects of IKS with a focus on the Vedic Corpus, including the Vedas and Vedāngas, and their relevance in shaping Indian thought and culture.	

Unit1. Foundations of Indian Knowledge System: Introduction to IKS,Overview of the Vedas and Vedangas,Messages and classifications in the Vedas, Basics of Vedic life and philosophical underpinnings
Unit 2. Philosophical Systems and Development ,Overview of major philosophical systems (Sankhya, Yoga, Nyaya, Vaisheshika, Mimamsa, Vedanta, Jaina, Buddhism, Charvaka),Development and unique features of Indian philosophy
Unit 3. Wisdom Traditions and Textual Insights,Exploration of Puranas and Itihasas,Analysis of Niti-shastras and Subhashitas, Extracting wisdom from ancient Indian texts
Unit4. Epistemology and Knowledge Framework,Understanding the Indian scheme of knowledge,Exploration of epistemological concepts (Pramana, Samshaya, Siddhanta)
Methods of establishing valid knowledge and logical frameworks
Unit5. Linguistic Studies and Language Sciences,introduction to linguistic studies in India
Study of Ashtadhyayi and phonetics,Role of Sanskrit in language processing and computational linguistics
Unit 6. Mathematics and Numerical Systems:Historical Indian number systems and mathematical concepts,Introduction to Bhuta-Sankhya and measurement systems, Exploration of Pingala and the binary system
Unit7. Health, Wellness, and Psychological Insights:Overview of Ayurveda and its principles, Psychological aspects of health and wellness,Indian approaches to psychology and consciousness studies
Unit 8. Urban Planning, Architecture, and Iconography:Perspective of Arthashastra on town planning,Introduction to Vastu Shastra and architectural principles, Iconographic aspects of Indian architecture and temple construction
Unit 9. Governance, Administration, and Ethical Principles: Understanding Rajadharma and Arthashastra,Analysis of administrative setups and governance models, Exploration of ethical principles in public administration and leadership
Text & Reference Books
1. Murthy, GRK, Epic Leadership: Timeless Lessons from Ramayana, Vive Books-Ed. 1. ISBN: 9386243318.
2. Oberoi, Meera.Leadership Secrets from Mahabharata, 13th Edition, Penguin

For Vivekananda Global University, Jaipur

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Centre for Distance and Online Education-VGU

Arvind Kumar Singh

Director

Semester: I	Core / Elective: Core
Teaching Scheme in Hrs (L:T:P):	Credits: 2
Type of course: Lecture+ Assignments	Total Contact Hours:
Continuous Internal Evaluation:	ESE:

Course Outcomes:
CO 1: Identify and define key universal human values.
CO 2: Analyze the cultural and historical contexts that shape human values.
CO 3: Apply universal human values to real-life situations and ethical dilemmas.
CO 4: Reflect on personal values and their alignment with universal human values.
CO 5: Engage in constructive dialogue and debate about value conflicts.

Unit 1: Exploring the Self
* Characteristics of Universal Human Values.
* Difference between value-based education and skill-based education.
* Self-Exploration - Meaning and Process.
* Basic Human Aspirations – Meaning and Basic Requirements for fulfilling.

Unit 2: Understanding Harmony – Self and Family
* Concept of Human Existence – Conscious and Material Entities.
* Difference between the Conscious and the Material Entities of Human Existence.
* Relationship as the basis of harmony in the family.
* Exploring the value of feelings in relationships.
* Measures to ensure Harmony.

Unit 3: Understanding Harmony in Society and Professional Ethics
* Understanding conflict (meaning, types).
* Dimensions of Human order for harmony in society.
* The universal values of justice, democracy, respect, and gratitude.
* Need for a code of ethics (philosophy references for ethics).
* Integrating Inclusiveness.

Unit 4: Understanding Harmony in Nature
* Meaning of harmony in nature.
* Disharmony with Nature – Causes and Implications.
* Harmony through mutual fulfillment of the four orders in nature.
* Harmony through a symbiotic relationship with nature.
* Achieving competence in maintaining harmony with nature in professional life..

Unit 5: Holistic Perspective of Harmony at all levels of Existence and current issues due to disharmony – Harmony with Self
* Existence as Units And Existence as coexistence.
* Application of harmony through coexistence through the integration of Universal Human Values.
* Development of harmony in the existential sense.
* Current issues leading to disharmony at all levels.
* Application of Universal Human Values for resolution of current issues.

Recommended Textbooks / Readings

1. Man's Search for Meaning" by Viktor E. Frankl
2. "The Art of Happiness" by Dalai Lama XIV and Howard C. Cutler
3. "The Ethics of Ambiguity" by Simone de Beauvoir
4. "Justice: What's the Right Thing to Do?" by Michael J. Sandel
5. "The Power of Now: A Guide to Spiritual Enlightenment" by Eckhart Tolle

Course Name: Communication for Success	Course Code: UGCFS

For Vivekananda Global University, Jaipur

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Centre for Distance and Online Education-VGU

Arvind Kumar Singh

Director

Semester: I	Core / Elective: Core
Teaching Scheme in Hrs (L:T:P):	Credits: 2
Type of course: Lecture+ Assignments	Total Contact Hours:
Continuous Internal Evaluation:	ESE:

Course Outcomes

CO1: Understand the importance of Intellectual Property Rights (IPR), interpersonal skills, and team dynamics, and apply effective teamwork and collaboration techniques in professional settings.
CO2: Demonstrate leadership qualities by understanding key leadership factors and developing the ability to lead, motivate, and manage teams effectively.
CO3: Develop professional documentation skills by preparing resumes, CVs, bio-data, and cover letters tailored to job requirements.
CO4: Exhibit professional behavior and communication skills through proper interview etiquette, group discussions, extempore speaking, and personal presentation, ensuring readiness for real-world career opportunities.
Unit 1: Importance & Benefits of IPR, Developing Interpersonal Abilities, Team Building- Definition and Types, Team work skills, Qualities of a Team Player
Unit 2: Leadership- Understanding the qualities of a Good Leader, 4 Factors of Leadership, Bring out the Leader in You
Unit 3: Concepts of Resume, Curriculum Vitae and Bio-data, Resume – Information and Details, Sample Resume and Template, Cover Letter- Cover letter Writing, Sample Cover letter and Template
Unit 4: Basic Personal Hygiene, Professional Attire – Men& Women, Interview Etiquette Guide, Telephonic Interview- Importance and Preparation, Advantages and Disadvantages, Things to Remember, Video Interview- Preparation and Practice, Guide to a Successful Video Interview, Importance and Types of Personal Interviews, FAQs with Answers
Unit 5: Group Discussion Guide, Topics for Group Discussion, Mock GD
Unit 6: Guide to Successful Extempore, Extempore Topics, Practice Session

Text/Reference Books:

1. Business communication Design, Angell, Pamela, Mcgraw-Hill, New York.
2. Grammar Finder, Eastwood, John, Oxford university press.
3. Effective technical communication, Mitra, K. Barun, Oxford university press.
4. Communicate to conquer: A handbook of group discussion and interviews, PHI learning, New Delhi

For Vivekananda Global University, Jaipur
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Centre for Distance and Online Education-VGU
Arvind Kumar Singh
Director

Course Name: Differential Equations	Course Code: UGMAT112
Semester: 2	Core / Elective: Core
Teaching Scheme in Hrs (L:T:P):	Credits: 4
Type of course: Lecture+ Assignments	Total Contact Hours: 12
Continuous Internal Evaluation:	ESE:

Course Outcomes: Upon successful completion, the student will be able to

CO1: Solve first-order and higher-order ordinary differential equations using appropriate analytical methods, such as separation of variables, integrating factors, and variation of parameters.

CO2: Apply differential equations to model and analyze problems arising in physics, biology, economics, and engineering contexts.

CO3: Construct and analyze solutions of linear differential equations with constant coefficients and system of differential equations using matrix methods and Laplace transforms.

CO4: Use power series solutions and special functions (e.g., Legendre, Bessel) to solve second-order linear differential equations around regular points.

CO5: Interpret the behavior of solutions through phase plane analysis and direction fields, and analyze stability and qualitative behavior of nonlinear systems.

Unit 1: Formation and Basic Concepts of Differential Equations

This unit introduces the formation of differential equations and explains fundamental concepts such as order, degree, and solution of differential equations. It focuses on first order and first degree equations and the interpretation of general and particular solutions.

Unit 2: Methods of Solving First Order Differential Equations

This unit covers standard methods for solving differential equations of first order and first degree. It includes separation of variables, homogeneous equations, and linear differential equations. The unit emphasizes systematic procedures for obtaining solutions.

Unit 3: Special Types of Differential Equations

This unit discusses Bernoulli's differential equations, exact differential equations, and equations reducible to exact form. It explains techniques to identify and transform equations into solvable forms, enhancing problem-solving skills.

Unit 4: Equations Solvable for Different Variables

This unit focuses on first order differential equations that are not of first degree. It explains methods for solving equations that are solvable for p, x, and y, highlighting different approaches depending on the form of the equation.

Unit 5: Clairaut's Equations and Singular Solutions

This unit introduces Clairaut's equations and explains their general and singular solutions. It emphasizes the geometric interpretation of singular solutions and their significance in differential equations.

Unit 6: Advanced Solution Techniques for Higher Degree Equations

This unit discusses methods for solving complex first order equations that do not follow standard forms. It integrates various approaches to handle equations of higher degree effectively.

Unit 7: Linear Differential Equations with Constant Coefficients

This unit explains linear differential equations of higher order with constant coefficients. It introduces the concepts of complementary function and particular integral, and methods to obtain complete solutions.

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Unit 8: Methods of Finding Complementary Function and Particular Integral This unit focuses on techniques used to determine complementary functions and particular integrals. It includes systematic approaches for solving non-homogeneous equations.
Unit 9: Homogeneous Equations with Variable Coefficients This unit discusses homogeneous linear differential equations with variable coefficients. It highlights the differences from constant coefficient equations and methods used for solving them.
Unit 10: Exact Form and Transformation Methods This unit explains second order linear differential equations with variable coefficients in exact form. It includes methods such as change of dependent variable (normal form) and change of independent variable to simplify equations.
Unit 11: Factorization Method This unit introduces the factorization method for solving second order differential equations. It explains how differential operators can be factorized to obtain solutions efficiently.
Unit 12: Variation of Parameters Method This unit discusses the method of variation of parameters as a powerful technique for solving non-homogeneous differential equations. It explains the procedure and applications of this method in finding particular solutions.
Unit 13: Formation and Classification of Partial Differential Equations This unit introduces partial differential equations, including their formation, order, and degree. It explains the classification of second order partial differential equations into elliptic, parabolic, and hyperbolic types through illustrations.
Unit 14: First Order Partial Differential Equations This unit focuses on first order partial differential equations and their standard forms. It explains Lagrange's equations and methods for solving them systematically.
Unit 15: Advanced Methods in Partial Differential Equations This unit discusses Charpit's general method for solving nonlinear first order partial differential equations. It highlights advanced techniques and their applications in solving complex problems.
Practical's: Every student must perform experiments from the following list. Verify the solution of ODE. Initial and Boundary-Value Problems. Separation of Variables. Homogeneous Equation of First Order. Exact Differential Equation of First Order. Linear Differential Equation of first Order. Computation of Wronskian. Principal of superposition. Solution of second order differential equation (Cauchy–Euler Equations). Solution of third order differential equation (Higher-Order Cauchy–Euler Equations). Verify the Solution of PDE. Separation of Variables. Plot the Integral Surfaces of Cauchy Problem of First order PDE. Solution of Two Dimension Laplace Equation. Solution of One Dimension Heat Equation. Solution of Wave Equation. Verify the Solution of System of ODE. Solution of System of ODE with initial data.

Suggested Books:

Ray M. and Chaturvedi J.C., (1962), A Text Book of Differential Equations, Third Edition, Students Friends & Co. Publisher, Agra.

Raisinghania M.D., (2020), Ordinary differential equations, Twentyth Edition, S. Chand Publications.

Ramana B.V., (2006), Higher Engineering Mathematics, Tata McGraw Hill.

Edwards C.H. and Penny D.E., (2005), Differential Equations and Boundary Value problems Computing and Modeling, Pearson Education India.

Course Name: Electricity and magnetism	Course Code: UGPHY112
Semester: 2	Core / Elective: Core
Teaching Scheme in Hrs (L:T:P):	Credits: 4
Type of course: Lecture+ Assignments	Total Contact Hours: 12
Continuous Internal Evaluation:	ESE:

Course Outcomes:
Upon successful completion, the student will be able
CO1: **Analyze** electric fields and potentials for various continuous charge distributions using Gauss's law and differential operators.
CO2: **Solve** boundary value problems in electrostatics by applying Laplace's and Poisson's equations with appropriate coordinate systems and boundary conditions.
CO3: **Apply and evaluate** advanced techniques like method of images and multipole expansion to determine potential and field configurations.
CO4: **Analyze and interpret** magnetic fields generated by arbitrary current distributions using Biot–Savart law, Ampere's law, and vector potentials.
CO5: **Explain and assess** magnetic properties of materials and fundamental electrodynamics concepts such as induction, magnetization, and electromagnetic energy storage.

Unit 1: Electric Field for Continuous Charge Distributions
Electric field due to continuous charge distributions is determined for line, surface, and volume charges by integrating contributions from infinitesimal charge elements. The divergence of the electric field is expressed using Dirac delta function, representing charge density at a point. The curl of the electric field is zero in electrostatics, indicating its conservative nature.

Unit 2: Electric Potential and Gauss's Law
The electric field vector can be expressed as the negative gradient of scalar potential, showing the relationship between field and potential. Electric potential may have ambiguities due to arbitrary reference points. Gauss's Law relates the electric flux through a closed surface to the enclosed charge and is expressed in both differential and integral forms.

Unit 3: Applications of Gauss's Law
Gauss's Law is applied to determine electric fields for systems with spherical, cylindrical, and planar symmetries. These applications simplify calculations for symmetric charge distributions and provide insight into field behavior in different geometries.

Unit 4: Laplace and Poisson Equations
Boundary value problems in electrostatics are governed by Laplace's and Poisson equations, which describe the behavior of electric potential in regions with and without charge. These equations form the basis for solving electrostatic problems.

Unit 5: Uniqueness Theorems and Solutions
The first and second uniqueness theorems ensure that the solution to electrostatic problems is unique under given boundary conditions. Solutions of Laplace's and Poisson equations are obtained in one dimension using spherical and cylindrical coordinates, and in three dimensions using Cartesian coordinates with the method of separation of variables.

Unit 6: Electrostatic Boundary Conditions
Boundary conditions define the behavior of electric fields and potentials at the interfaces of conductors and capacitors. These conditions are essential for solving practical electrostatic problems and determining field distributions.

Unit 7: Method of Images
The method of images is used to simplify electrostatic problems by replacing conductors with

imaginary charges. It is applied to systems involving a point charge and continuous charge distributions near an infinite plane sheet or a spherical conductor maintained at constant potential.
Unit 8: Multipole Expansion and Potentials Multipole expansion is used to approximate the potential at large distances from a charge distribution. It includes monopole, dipole, and quadrupole terms, which describe the contribution of different charge configurations using Legendre polynomials.
Unit 9: Dipole Potential and Field The electric field due to a dipole is obtained as the negative gradient of the dipole potential in spherical coordinates. This provides a detailed understanding of field distribution and directional dependence in dipole systems.
Unit 10: Magnetic Field and Its Properties Magnetic field is characterized by its divergence and curl. The divergence of magnetic field is zero, indicating the absence of magnetic monopoles, while its curl is related to current distribution.
Unit 11: Laws of Magnetostatics The magnetic field due to arbitrary current distributions is calculated using the Biot-Savart law. Ampere's Law relates magnetic field circulation to the current enclosed and is expressed in both integral and differential forms.
Unit 12: Vector Potential and Gauge Conditions The magnetic vector potential is used to describe magnetic fields and has certain ambiguities due to gauge freedom. The Coulomb gauge condition ensures that the vector potential is divergenceless. Vector potential for line, surface, and volume currents is determined using Poisson equations.
Unit 13: Magnetization and Magnetic Properties of Matter Magnetization describes the magnetic moment per unit volume of a material. Bound currents arise due to magnetization, and magnetic intensity defines the magnetic field in materials. Magnetic susceptibility and permeability characterize material response to magnetic fields, while ferromagnetism is explained using Hund's rule.
Unit 14: Ampere's Law in Magnetized Materials Ampere's Law is extended to include magnetized materials, incorporating the effects of bound currents. It is expressed in both differential and integral forms to describe magnetic behavior in matter.
Unit 15: Electrodynamics and Energy Considerations Electrodynamics involves changing magnetic fields and induced electric fields as described by Faraday's Law and Lenz's Law. Concepts such as inductance, electromotive force, and Ohm's law describe electrical behavior in circuits. The energy stored in a magnetic field is an important aspect of electromagnetic systems.
Every student must perform at least 06 experiments. 1) Measurement of current and charge sensitivity of ballistic galvanometer 2) Measurement of critical damping resistance of ballistic galvanometer 3) Determination of a high resistance by leakage method using ballistic Galvanometer. 4) Measurement of field strength B and its variation in a solenoid (determine dB/dx) 5) Determination of an unknown low resistance by Carey Foster's Bridge 6) Measurement of self-inductance of a coil by Anderson's Bridge. 7) Measurement of self-inductance of a coil by Owen's Bridge. 8) To determine the mutual inductance of two coils by the Absolute method. 9) Explore magnetic properties of matter using Arduino: To verify Faraday's law and Lenz's law by measuring the induced voltage across a coil subjected to the varying magnetic field. Also, estimate the dipole moment of the magnet.

Suggested Books:

Electricity, Magnetism and Electromagnetic Theory, S. Mahajan and Choudhury, 2012, Tata McGraw
Feynman Lectures Vol.2, R. P. Feynman, R. B. Leighton, M. Sands, 2008,
Pearson Education
Electricity and Magnetism, J. H. Fewkes and J. Yarwood, Vol. I, 1991,
Oxford Univ. Press.
Introduction to Electrodynamics, D. J. Griffiths, 3rd Edn., 1998, Benjamin Cummings

Course Name: Bio-Organic Chemistry	Course Code: UGCHM113
Semester: 2	Core / Elective: Core
Teaching Scheme in Hrs (L:T:P):	Credits: 4
Type of course: Lecture+ Assignments	Total Contact Hours: 12
Continuous Internal Evaluation:	ESE:

Course Outcomes:
CO1; Students will be able to understand the connection and chemistry of biochemical and organic reactions.
CO2: Students will able to analyze the classification and structure of proteins and amino acids.
CO3: Students will be able to analyze the structure and biological importance of nucleic acids.
CO4: Students will be able to study the classification, properties and biological importance of enzymes and lipids.
CO5: Students will be able to gain knowledge about the mutarotation, structures and role of carbohydrates & to analyze amino acids and proteins.

Unit 1: Fundamentals of Bioorganic Chemistry
Bioorganic chemistry deals with the application of organic chemistry principles to biological systems. It establishes the connection between organic chemistry and biological processes by explaining how organic molecules participate in life functions. The chemistry of the living cell involves complex molecular interactions that resemble organic reactions, highlighting the analogy between biochemical and organic reactions.

Unit 2: Weak Interactions and Proximity Effect
Weak interactions such as hydrogen bonding, van der Waals forces, and electrostatic interactions play a crucial role in both organic and biological systems. These interactions contribute to molecular stability and function. The proximity effect in organic chemistry explains how the closeness of functional groups enhances reaction rates and specificity, which is also significant in biological systems.

Unit 3: Molecular Recognition in Biological Systems
Molecular recognition refers to the specific interaction between molecules through non-covalent bonding. It is essential in biological processes such as enzyme-substrate binding and receptor-ligand interactions. These selective interactions demonstrate the precision and efficiency of biochemical reactions.

Unit 4: Classification and Properties of Amino Acids
Amino acids are the building blocks of proteins and are classified into essential and non-essential amino acids based on dietary requirements. They are also categorized as protein and non-protein amino acids. Amino acids exist as zwitter ions in solution, possessing both positive and negative charges, which influence their chemical behavior.

Unit 5: Classification and Structure of Proteins
Proteins are classified based on shape and solubility into fibrous and globular proteins, and based on structural complexity. The structure of proteins is organized into primary, secondary, tertiary, and quaternary levels, each contributing to the stability and functionality of proteins.

Unit 6: Isoelectric Point and Biological Significance of Proteins
The isoelectric point is the pH at which a protein or amino acid carries no net charge. This property is important for protein purification and function. Proteins play vital biological roles including enzymatic activity, structural support, transport, and regulation of biological processes.

Unit 7: Components of Nucleic Acids
Nucleic acids are composed of nitrogenous bases, sugars, and phosphate groups. The nitrogenous

bases are classified into purines and pyrimidines. Nucleosides consist of a base and sugar, while nucleotides include a phosphate group in addition to the nucleoside.
Unit 8: Structure of DNA and RNA DNA and RNA are the primary nucleic acids responsible for genetic information storage and expression. DNA has a double helical structure, while RNA exists in different forms such as mRNA, tRNA, and rRNA, each performing specific functions in protein synthesis.
Unit 9: Biological Importance of Nucleic Acids Nucleic acids are essential for heredity and protein synthesis. The 16S rRNA plays a significant role in the identification and classification of microorganisms and is crucial in ribosomal function and evolutionary studies.
Unit 10: Enzymes: Classification and Function Enzymes are biological catalysts classified and named based on the reactions they catalyze. Isoenzymes are different forms of enzymes that catalyze the same reaction, while multi-enzyme complexes consist of several enzymes working together. Enzymes exhibit high specificity due to the presence of an active site.
Unit 11: Enzyme Activity and Assays The measurement and expression of enzyme activity involve determining the rate of reaction catalyzed by enzymes. Enzyme assays are used to study enzyme kinetics and functionality, providing insights into biochemical pathways and regulatory mechanisms.
Unit 12: Lipids: Structure, Classification and Biological Importance Lipids are a diverse group of biomolecules including fatty acids, phospholipids, and steroids. They are classified based on their structure and properties. Lipids play a key role in cell membrane structure, energy storage, and signaling. Cholesterol and steroid hormones are important for maintaining cellular functions and physiological regulation.
Unit 13: Classification and Structure of Carbohydrates Carbohydrates are classified into monosaccharides, disaccharides, oligosaccharides, and polysaccharides. Their nomenclature is based on functional groups and carbon atoms. They exist in open-chain and closed-chain forms and exhibit isomerism including epimers and enantiomers, as well as mutarotation.
Unit 14: Monosaccharides and Disaccharides Monosaccharides such as glucose and fructose serve as primary energy sources. Sugar alcohols like mannitol and sorbitol have physiological importance. Disaccharides such as sucrose, maltose, and lactose are formed by the linkage of monosaccharides and play roles in energy metabolism.
Unit 15: Oligosaccharides and Polysaccharides Oligosaccharides and polysaccharides are complex carbohydrates involved in structural and storage functions. Starch serves as a storage polysaccharide in plants, while cellulose provides structural support. These carbohydrates are essential for biological systems and energy balance.

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Director

Course Name: Data structures using C	Course Code: UGCSA112
Semester: 2	Core / Elective: Core
Teaching Scheme in Hrs (L:T:P):	Credits: 4
Type of course: Lecture+ Assignments	Total Contact Hours:
Continuous Internal Evaluation:	ESE:

Course Outcomes: This course will enable the students to learn:
CO1: The student will develop an ability to read, write, and analyze the time and space complexity of any algorithms.
CO2: Able to describe the properties, behavior, and implementation of basic data structures like Stacks, Queues, Linked List, Trees, and Graphs.
CO3: Able to convert pseudocode to its appropriate C code implementation.
CO4: Able to compare different searching and sorting techniques.
CO5: Able to design and implement different hash functions, and hash tables.

Unit 1: Fundamentals of Data Structures and Algorithms
Data structures are organized ways of storing and managing data to enable efficient access and modification. Concepts such as data types, abstraction, and classification of data structures into linear and non-linear types form the foundation. Algorithms are step-by-step procedures used to solve problems, and pseudocode is used to represent them in a structured and language-independent manner.

Unit 2: Algorithm Analysis and Complexity
Algorithm analysis focuses on evaluating efficiency in terms of time and space. Complexity analysis includes time complexity, space complexity, and the concept of time-space trade-off. This helps in selecting appropriate algorithms based on performance requirements.

Unit 3: Arrays and Searching Techniques
Arrays are fundamental data structures used to store elements in contiguous memory locations. Address calculation is important for single and multi-dimensional arrays. Searching techniques such as linear search and binary search are used to locate elements, with binary search being more efficient for sorted data.

Unit 4: Stack Operations and Applications
Stacks are linear data structures that follow the Last In First Out principle. They can be implemented using arrays or linked lists. Applications include expression evaluation and conversion between infix, postfix, and prefix notations.

Unit 5: Queues and Their Variants
Queues follow the First In First Out principle and can be implemented using arrays or linked lists. Variants such as circular queues and double-ended queues improve efficiency and flexibility in operations.

Unit 6: Linked Lists and Priority Queues
Linked lists are dynamic data structures including singly and doubly linked lists, with circular variations. Operations include insertion, deletion, and traversal. Priority queues are specialized structures where elements are processed based on priority, and they have various practical applications.

Unit 7: Tree Concepts and Types
Trees are non-linear data structures consisting of nodes connected hierarchically. Basic terminology includes root, parent, child, and leaf nodes. Types of trees include binary trees, binary search trees, AVL trees, B-trees, and heaps.

Unit 8: Tree Representation and Traversal
Trees can be represented using arrays or linked structures. Traversal algorithms such as inorder,

preorder, and postorder are used to visit nodes systematically and are essential for processing tree data.
Unit 9: Tree Operations and Applications Tree operations include insertion, deletion, and searching. Trees are widely used in applications such as database indexing, expression evaluation, and hierarchical data representation.
Unit 10: Graph Fundamentals and Representation Graphs consist of vertices and edges and are used to model relationships. They are classified into different types such as directed, undirected, and weighted graphs. Graphs can be represented using adjacency matrices and adjacency lists.
Unit 11: Graph Traversal and Connectivity Graph traversal techniques include breadth-first search and depth-first search, which are used to explore nodes. Connectivity determines whether all vertices are reachable, and spanning trees represent subgraphs connecting all vertices without cycles.
Unit 12: Shortest Path and Minimum Spanning Tree Shortest path algorithms are used to find the minimum distance between nodes in weighted graphs. Minimum spanning trees connect all vertices with minimum total edge weight and are important in network design.
Unit 13: Sorting Algorithms Sorting algorithms arrange data in a specific order. Common techniques include selection sort, bubble sort, insertion sort, quick sort, merge sort, and heap sort, each with different performance characteristics.
Unit 14: Performance Analysis of Sorting Techniques The efficiency of sorting algorithms is analyzed based on time complexity, space usage, and stability. Comparing different sorting methods helps in selecting the most suitable algorithm for a given problem.
Unit 15: Hashing Techniques and Collision Resolution Hashing is used to store and retrieve data efficiently using hash functions. Hash tables are constructed to map keys to values, and collision resolution techniques such as open hashing and universal addressing are used to handle conflicts.
List of Practical: Program to insert element at desire position, replacing element, deletion in array. Program on various matrices operations. Program on array searching (Linear and Binary) Implementation of stack and queue using array and basic operations Implementation of stack and queue using link lists Implementation of circular queue using link lists. Infix to postfix/prefix conversion. Singly and doubly linked lists. Implementation of Sorting Techniques

TEXT BOOK (S)

Aaron M. Tenenbaum, Yedidyah Langsam, Moshe J. Augenstein, "Data Structures using C ", Pearson.1st Edition.2019

Schaum's outline series, "Data structures with C", McGraw Hill Education; 1st edition (July 2017)

REFERENCE BOOKS

Horowitz and Sahani, "Fundamentals of Data Structures", Galgotia Publication, 2nd Edition. 2008.

Robert Kruse, "Data Structures and Program Design in C", PHI.2nd Edition.2006.

Kyle Loudon, "Mastering Algorithms with C", O'Reily Publication, 1st Edition, 1999

For Vivekananda Global University, Jaipur

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Arvind Kumar Singh

Director

Course Name: Systematics & Animal Diversity	Course Code: UGZOO111

Semester: 2	Core / Elective: Core
Teaching Scheme in Hrs (L:T:P):	Credits: 4
Type of course: Lecture+ Assignments	Total Contact Hours: 12
Continuous Internal Evaluation:	ESE:

Course Outcomes: Upon successful completion, the student will be able to

CO1: Understand the principles and stages of taxonomy, including modern trends such as ecological, cytological, and numerical approaches, to classify organisms effectively.

CO2: Analyze different species concepts (typological, biological, evolutionary) and apply the rules of zoological nomenclature to identify and name animal taxa accurately.

CO3: Describe the general characteristics and classification of major invertebrate phyla (Protista, Porifera, Cnidaria, Annelida, Platyhelminthes, Nemathelminthes, Arthropoda, Mollusca, Echinodermata), emphasizing their structural and functional adaptations.

CO4: Evaluate the life histories and parasitic adaptations of key organisms, such as Taenia solium, Ascaris lumbricoides, and parasitic protozoans (Entamoeba, Trypanosoma, Giardia, Leishmania), to propose effective control measures.

CO5: Apply knowledge of specialized biological features, such as the canal system in Porifera, polymorphism in Cnidaria, metamerism in Annelida, vision in Arthropoda, torsion in Mollusca, and the water-vascular system in Echinodermata, to assess their evolutionary significance.

Unit 1: Introduction to Taxonomy
Definition and scope of taxonomy
Stages of taxonomy: Alpha, Beta, Gamma taxonomy
Importance and applications of taxonomy
Unit 2: Principles, Problems, Aim and Tasks of Taxonomy
Aims and objectives of taxonomy
Tasks in taxonomic studies
Problems and limitations in taxonomy
Unit 3: Modern Trends in Taxonomy
Ecological and behavioural approaches
Cytological and biochemical taxonomy
Numerical taxonomy and its significance
Unit 4: Kinds of Classification
Phenetic classification
Natural classification
Phylogenetic and evolutionary classification
Omnispective classification
Unit 5: Concept of Species
Typological, Biological, Nominalistic species concepts
Evolutionary and Recognition species concepts
Species number, polytypic species and subspecies
Unit 6: Taxonomic Categories and Nomenclature
Infraspecific groups and superspecies
Taxonomic identification methods
Origin and principles of zoological nomenclature
Rules of International Code of Zoological Nomenclature (ICZN)
Unit 7: Kingdom Protista
General characters
Classification up to classes
Locomotory organelles and locomotion in Protozoa

Unit 8: Phylum Porifera
General characters and classification up to classes
Canal system in *Sycon*
Unit 9: Phylum Cnidaria
General characters and classification up to classes
Polymorphism in Hydrozoa
Unit 10: Phylum Annelida
General characters and classification up to classes
Metamerism in Annelida
Unit 11: Phylum Platyhelminthes
General characters and classification up to classes
Life history of *Taenia solium*
General characters and classification up to classes
Life history of *Ascaris lumbricoides*
Parasitic adaptations
Unit 12: Phylum Arthropoda
General characters and classification up to classes
Vision in Arthropoda
Metamorphosis in insects
Unit 13: Phylum Mollusca and Echinodermata
Mollusca: General characters, classification, torsion in gastropods
Echinodermata: General characters and classification
Water vascular system in Asteroidea
Unit 14: Parasitic Protozoans of Humans
Entamoeba, *Trypanosoma*, *Giardia*, *Leishmania*
Mode of infection
Preventive and control measures
Practicals: 1. Study of the following specimens: Amoeba, Euglena, Plasmodium, Paramecium, Sycon, Hyalonema, and Euplectella, Obelia, Physalia, Aurelia, Tubipora, Metridium, Taeniasolium, Male and female Ascarislumbricoides, Aphrodite, Nereis, Pheretima, Hirudinaria, Palaemon, Cancer, Limulus, Palamnaeus, Scolopendra, Julus, Periplaneta, Apis, Chiton, Dentalium, Pila, Unio, Loligo, Sepia, Octopus, Pentaceros, Ophiura, Echinus. 2. Study of the following permanent slides: T.S. and L.S. of Sycon, Study of life history stages of Taenia, T.S. of Male and female Ascaris 3. Taxonomy i. Identification, Classification and study of animals from major invertebrates groups (protozoa to hemichordate including minor phyla using museum specimens, microscopic slides, models or charts or photographs. ii. Preservation Techniques of selected invertebrates iii. Visit to a pond/lake/river/sea: Collection, preservation, and identification of animals.

Books Suggested:

1. Invertebrate Zoology by R.D. Barnes – (W.B.Saunders, Philadelphia)
2. A manual of Zoology, Vol.1 by Ekambernatha Ayyar (Vishwanathan, Madras).
3. The invertebrate series of L.H.Hyman – (McGraw Hill)
4. A student's textbook of Zoology by Adam Sedgwick Vol. I, II & III – (Central Book Depot, Allahabad).
5. A Text book of Zoology vol.1 by Parkar and Haswell – (Macmillan)

Course Name: BIODIVERSITY OF ARCHEGONIATES	Course Code: UGBOT112

Semester: 2	Core / Elective: Core
Teaching Scheme in Hrs (L:T:P):	Credits: 4
Type of course: Lecture+ Assignments	Total Contact Hours: 12
Continuous Internal Evaluation:	ESE:

Course Outcomes: Upon successful completion, the student will be able
CO1: Describe characteristics, classification, structure, reproduction, and importance of bryophytes.
CO2: Apply structural and reproductive features to illustrate life cycles of Riccia, Marchantia, and Anthoceros.
CO3: Analyze life cycles and phylogenetic relationships of Funaria and Sphagnum.
CO4: Evaluate stele evolution, sporangia types, heterospory, and seed habit in Pteridophytes.
CO5: Design comparative studies on Psilotum, Selaginella, Equisetum, Adiantum, Pteridium, and Marsilea.

Unit 1: General Characteristics, Origin, and Evolution
Bryophytes are non-vascular plants that occupy an intermediate position between algae and pteridophytes. They are considered the first land plants and show adaptations to terrestrial life. Their origin and evolution reflect transition from aquatic to land habitats.

Unit 2: Classification and Habitat Range
Bryophytes are classified based on systems proposed by Eichler and Proskauer. They are commonly found in moist and shaded environments, showing a wide habitat range.

Unit 3: Structure, Reproduction, and Economic Importance
Bryophytes exhibit simple thallus or leafy structures. They reproduce vegetatively, asexually, and sexually, showing alternation of generations. They have ecological and economic importance, including soil formation and water retention.

Unit 4: Hepaticopsida – Habitat and Structure
Hepaticopsida (liverworts) such as Riccia and Marchantia are found in moist habitats. They have thalloid or leafy structures with simple organization.

Unit 5: Reproduction and Life Cycle of Hepaticopsida
Reproduction includes vegetative propagation, asexual spores, and sexual reproduction. Their life cycle shows alternation of generations with dominant gametophyte stage.

Unit 6: Anthoceropsida – Structure, Reproduction, and Life Cycle
Anthoceropsida (hornworts) such as Anthoceros have unique elongated sporophytes. Their reproduction and life cycle also show alternation of generations with distinct features.

Unit 7: Habitat, Structure, and Life Cycle of Funaria and Sphagnum
Bryopsida (mosses) such as Funaria and Sphagnum are found in moist habitats. They have differentiated structures and complex life cycles with dominant gametophyte.

Unit 8: Reproduction and Sterilization of Sporogenous Tissue
Bryophytes show advanced reproductive mechanisms, including sterilization of sporogenous tissues leading to specialized structures in the sporophyte.

Unit 9: Phylogeny and Importance of Bryophytes
Bryophytes show evolutionary relationships with Hepaticopsida and Bryopsida. They play important ecological roles and have economic significance.

Unit 10: General Characteristics, Origin, and Classification
Pteridophytes are vascular plants with true roots, stems, and leaves. Their classification is based on systems like G.M. Smith, reflecting evolutionary relationships.

Unit 11: Structural Evolution and Sporangial Development
The evolution of stele and development of sporangia (eusporangiate and leptosporangiate) are key features. They show structural complexity compared to bryophytes.

Unit 12: Life Cycle Patterns and Special Phenomena Pteridophytes exhibit homospory and heterospory. Concepts like heterospory, seed habit, apospory, and apogamy represent evolutionary advancements.
Unit 13: Psilotophyta and Lycophyta Psilotophyta (Psilotum) and Lycophyta (Selaginella) show primitive vascular plant features with distinct morphology, anatomy, and reproduction.
Unit 14: Sphenophyta and Pterophyta Sphenophyta (Equisetum) and Pterophyta (Adiantum, Pteridium, Marsilea) exhibit advanced structures and reproductive adaptations.
Unit 15: Economic Importance of Pteridophytes Pteridophytes are important for ecological balance, soil conservation, ornamental use, and medicinal applications.
Practicals: *Riccia*– Morphology of thallus. *Marchantia*- Morphology of thallus, whole mount of rhizoids & Scales, vertical section of thallusthrough Gemma cup, whole mount of Gemmae (all temporary slides), vertical section of Antheridiophore, Archegoniophore, longitudinal section of Sporophyte (all permanent slides *Sphagnum*- Morphology of plant, whole mount of leaf (permanent slide only). *Funaria*- Morphology, whole mount of leaf, rhizoids, operculum, peristome, annulus, spores (temporary slides); permanent slides showing antheridial and archegonial heads, longitudinal *Selaginella*- Morphology, whole mount of leaf with ligule, transverse section of stem, whole mount of strobilus, whole mount of microsporophyll and megasporophyll (temporary slides),longitudinal section of strobilus (permanent slide). *Equisetum*- Morphology, transverse section of internode, longitudinal section of strobilus,transverse section of strobilus, whole mount of sporangiophore, whole mount of spores (wet and dry) (temporary slide), transverse section of rhizome (permanent slides) *Cycas*- Morphology (coralloid roots, bulbil, leaf), whole mount of microsporophyll, transverse section of coralloid root, transverse section of rachis, vertical section of leaflet, vertical section of microsporophyll, whole mount of spores (temporary slides), longitudinal section of ovule, transverse section of root (permanent slide). *Pinus*- Morphology (long and dwarf shoots, whole mount of dwarf shoot, male and female cones), transverse section of Needle, transverse section of stem, longitudinal section of /transverse section of male cone, whole mount of microsporophyll, whole mount of Microspores.

Books Suggested:

Vashistha, P.C., Sinha, A.K., Kumar, A. (2010). Pteridophyta. S. Chand. Delhi, India.
Bhatnagar, S.P. & Moitra, A. (1996). Gymnosperms. New Age International (P) Ltd Publishers,New Delhi,
Parihar, N.S. (1991). An introduction to Embryophyta: Vol. I. Bryophyta. Central Book Depot.Allahabad.
Raven, P.H., Johnson, G.B., Losos, J.B., Singer, S.R. (2005). Biology. Tata McGraw Hill, Delhi.
Vanderpoorten, A. &Goffinet, B. (2009) Introduction to Bryophytes. Cambridge University

Digital Reference:

https://www.geobotany.uaf.edu/teaching/plant_keys/bryophytes.pdf
https://www.biologydiscussion.com/botany/bryophytes/bryophytes-botany-notes-on-bryophytes-plants/59046
https://gurukpo.com/Content/B.SC/Pteridophytes_Gymnosperms_&_Palaeobotany.pdf
https://courses.lumenlearning.com/suny-biology2xmaster/chapter/gymnosperms/

Course Name: Fundamentals of Indian Constitution	Course Code: UGFIC
Semester: II	Core / Elective: Core

Teaching Scheme in Hrs (L:T:P):	Credits: 2
Type of course: Lecture+ Assignments	Total Contact Hours:
Continuous Internal Evaluation:	ESE:

Course Outcomes:
CO1Understand and explain the significance of Indian Constitution as the fundamental law of the land.
CO2. Exercise his fundamental rights in proper sense at the same time identifies his responsibilities in national building.
CO3. Analyse the Indian political system, the powers and functions of the Union, State and Local Governments in detail
CO4. Understand Electoral Process, Emergency provisions and Amendment procedure.
Course Contents
Unit 1: Constitution Assembly and Making of India's Constitution, Features of Indian Constitution, Preamble of India and Its Importance, Nature of Indian Federalism and Centre - State Relations, Fundamental Rights, Features, Kinds and Evaluation and Fundamental Duties
Unit 2: Directive Principles of State Policy, Parliament: Composition, Powers and Role, President: Elections, Power and Position, Indian Cabinet.
Unit 3: Prime Minister: Power and Changing Role, Supreme Court and High Court: Composition, Powers and Role
Unit4: Governor: Appointment, Powers and Role, State Legislature: Composition, Power and Role. Council of Ministers and Chief Minister – Powers and Role
Unit 5: District's Administration Head - Role and Importance, Municipalities - Mayor and role of Elected Representative – Pachayati Raj,Elected officials and their roles - Block level Organizational Hierarchy, Village level - Role of Elected and Appointed officials - Importance of grass-root democracy
Unit 6: Chief Election Commissioner - State Election Commission - Functions of Commissions for the welfare of SC/ST/OBC and women.
Further Readings:
1. Badyal, J.S. 2013: Indian Constitution, Jalandhar City, Raj Publishers (Regd.)
2. R.N Duggal, 2013: Indian Constitution and Indian Political System, Duggal Publishing House,Jalandhar

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Course Name: Banking and Insurance	Course Code: UGBAI
Semester: II	Core / Elective: Core

Teaching Scheme in Hrs (L:T:P):	Credits: 3
Type of course: Lecture+ Assignments	Total Contact Hours:
Continuous Internal Evaluation:	ESE:

Course Outcomes:

CO1 Apply knowledge in the field of Banking Sector in India.
CO2 Classify various services offered and risks faced by banks
CO3 Interpret the role of regulatory norms in banking sector
CO4 Apply knowledge in the field of insurance industry in India
CO5 Identify the various challenges and scope in the Banking and Insurance Sectors.

Unit 1
Banking Business in India, Banking Legislations, Structure of Indian Banking System, Recent Developments in Banking Industry,
Unit:2
Roles of Banks, Principles of Banking, Banker - Customer Relationship
Unit 3
Organization of bank lending (Loans and advances, Priority sector lending, Export credit), project and working capital finance,
Unit 4
Deposit and Credit Services, Payment and Remittance Services, Collection Services and the different products there under.
Unit 5
Practical banking, Annual reports and balance sheet of a bank, Electronic banking, (POS) Banking Regulatory Norms- Know your customer (KYC), Anti Money Laundering (AML) Guidelines.
Unit 6
Indian insurance industry: Transition and Prospects, legal frame work, insurance- Basic concepts and principles,
Unit 7
Classification of Insurance, reinsurance, Principles Governing Marketing of Insurance products.
Unit 8
Channels of distribution for insurance products, policy servicing and claim settlement, Registration of Insurance Companies.
Unit 9
Licensing of Insurance Agents, Professional standards, Code of Conduct for insurance agent, Protection of Policyholder's Interest.

Readings:

Bhattacharyya, S. K. (2017). Banking Strategy, Credit Appraisal, and Lending Decisions: A Risk-Return Framework. McGraw Hill Education. ISBN: 978-9385965727.
Varshney, P. & Bhattacharya, S. (2019). Insurance Principles and Practices. Himalaya Publishing House. ISBN: 978-9353241228.
Reddy, M. N. (2016). Banking Theory, Law & Practice. McGraw Hill Education. ISBN: 978-9385965055.
Mishra, B. (2018). Insurance and Risk Management. Vikas Publishing House. ISBN: 978-9325973947.
Gupta, N. (2015). Indian Financial System: Theory and Practice. Pearson India Education Services. ISBN: 978-9332549493.

Course Name: Environmental Science	Course Code: UGEVS
Semester: II	Core / Elective: Core

Teaching Scheme in Hrs (L:T:P):	Credits: 3
Type of course: Lecture+ Assignments	Total Contact Hours:
Continuous Internal Evaluation:	ESE:

Course Outcomes
CO1: Discover knowledge in ecological perspective and value of environment.
CO 2: Understand the significance of various natural resources and its management.
CO 3: Demonstrate a comprehensive understanding of the world's biodiversity and the importance of its conservation.
CO 4: Categorize different types of pollutions and their control measures. Discover effective methods of waste Management. Analyse global environmental problems and come out with best possible solutions and understand environmental laws and sustainable development.

Unit 1: Nature and Components of Environment
This unit introduces the multidisciplinary nature of environmental studies and explains the major components of the environment, including atmosphere, hydrosphere, lithosphere, and biosphere. It highlights the interrelationship among these components in maintaining ecological balance.

Unit 2: Scope and Importance of Environmental Studies
This unit discusses the scope and significance of environmental studies in understanding environmental issues and promoting awareness. It emphasizes the role of environmental education in addressing global and local challenges.

Unit 3: Sustainability and Sustainable Development
This unit explains the concept of sustainability and sustainable development. It focuses on balancing economic growth, environmental protection, and social well-being for long-term development.

Unit 4: Ecosystem Structure and Function
This unit explains the structure and functioning of ecosystems, including energy flow through food chains and food webs. It also discusses ecological succession and the dynamic nature of ecosystems.

Unit 5: Types of Ecosystems and Case Studies
This unit covers various ecosystems such as forest, grassland, desert, and aquatic ecosystems including ponds, streams, lakes, rivers, oceans, and estuaries. It uses case studies to illustrate their characteristics and functioning.

Unit 6: Biodiversity and Biogeography
This unit introduces levels of biological diversity including genetic, species, and ecosystem diversity. It also discusses biogeographical zones of India, biodiversity patterns, and global biodiversity hotspots.

Unit 7: Land and Water Resources
This unit explains land resources, land use changes, land degradation, soil erosion, and desertification. It also discusses water resources, including use and over-exploitation of surface and groundwater, floods, droughts, and water conflicts at national and international levels.

Unit 8: Atmospheric Processes and Climate Factors
This unit focuses on the heating of the Earth and circulation of air, including air mass formation and precipitation processes that influence climate and weather patterns.

Unit 9: Energy Resources and Environmental Impact
This unit discusses renewable and non-renewable energy sources, the use of alternative energy, and growing energy demands. It includes case studies to highlight the environmental impact of energy consumption. It also addresses deforestation and its causes and impacts due to mining and dam construction on forests, biodiversity, and tribal populations.

Unit 10: Types and Causes of Pollution This unit explains different types of environmental pollution, including air, water, soil, chemical, and noise pollution. It discusses their causes, effects, and control measures.
Unit 11: Health Hazards and Waste Management This unit focuses on nuclear hazards and associated human health risks. It also explains solid waste management and control measures for urban and industrial waste.
Unit 12: Pollution Case Studies This unit presents case studies of environmental pollution to illustrate real-world problems and their management strategies.
Unit 13: Global Environmental Issues This unit discusses major environmental issues such as climate change, global warming, ozone layer depletion, and acid rain. It explains their impacts on human communities and agriculture.
Unit 14: Environmental Laws and International Agreements This unit covers important environmental laws including the Environment Protection Act, Air Act, Water Act, Wildlife Protection Act, and Forest Conservation Act. It also explains international agreements such as the Montreal Protocol, Kyoto Protocol, Convention on Biological Diversity, and the Chemical Weapons Convention.
Unit 15: Conservation Practices and Social Issues This unit focuses on nature reserves, tribal populations and their rights, and human-wildlife conflicts in the Indian context. It highlights the importance of conservation practices and sustainable coexistence.

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Course Name: Real Analysis	Course Code: UGMAT201
Semester: 3	Core / Elective: Core
Teaching Scheme in Hrs (L:T:P):	Credits: 4
Type of course: Lecture+ Assignments	Total Contact Hours: 12
Continuous Internal Evaluation:	ESE:

Course Outcomes: This course will enable the students to learn:
CO1: Demonstrate understanding of fundamental concepts such as real number system, boundedness, completeness, and limits of sets and sequences.
CO2: Apply various convergence tests to analyze the behavior of infinite series and determine their convergence or divergence.
CO3: Examine properties of real sequences and continuous functions using formal definitions and theorems including Cauchy's criterion and intermediate value properties.
CO4: Analyze the nature of uniform convergence for sequences and series of functions and evaluate the implications for integration and differentiation.
CO5: Investigate the Riemann integrability of functions using Darboux sums and fundamental theorems of integral calculus to solve problems analytically.

Unit 1: Sets and the Real Number System
This unit introduces finite and infinite sets, along with examples of countable and uncountable sets. It explains the structure of the real line and discusses bounded sets, supremum, and infimum. The completeness property and Archimedean property of real numbers are studied, along with different types of intervals, providing a strong foundation for real analysis.

Unit 2: Topological Concepts in Real Analysis
This unit focuses on the concept of cluster points and their significance in analysis. It also introduces the Bolzano-Weierstrass theorem, which establishes the existence of convergent subsequences in bounded sequences, forming a key result in understanding compactness and convergence.

Unit 3: Properties and Applications of Real Numbers
This unit emphasizes the application of properties of real numbers in analysis. It integrates concepts such as boundedness, completeness, and intervals to analyze sequences and sets, forming a basis for further study of limits and convergence.

Unit 4: Convergence of Infinite Series
This unit introduces infinite series and the concept of convergence. It explains various tests such as comparison test, ratio test, and Cauchy's root test to determine convergence or divergence of series.

Unit 5: Advanced Convergence Tests
This unit covers advanced tests including Raabe's test, logarithmic ratio test, Cauchy's condensation test, De Morgan and Bertrand test, and Gauss test. These methods provide more refined tools for analyzing complex series.

Unit 6: Alternating Series and Types of Convergence
This unit discusses alternating series and the Leibnitz test for their convergence. It also explains the difference between absolute and conditional convergence, highlighting their importance in mathematical analysis.

Unit 7: Real Sequences and Boundedness
This unit introduces real sequences and explains bounded sequences. It discusses the behavior of sequences and the importance of bounds in determining convergence.

Unit 8: Convergence Criteria for Sequences
This unit explains the Cauchy convergence criterion for sequences and Cauchy's theorem on limits.

It also includes order preservation and the squeeze theorem, which are important tools for evaluating limits.
Unit 9: Monotone Sequences and Convergence This unit focuses on monotone sequences and their convergence. It introduces the monotone convergence theorem (without proof) and explains how monotonicity ensures convergence under bounded conditions.
Unit 10: Continuity and Its Properties This unit introduces continuity of functions and discusses boundedness and intermediate value properties of continuous functions. It emphasizes the significance of continuity in analysis.
Unit 11: Uniform Continuity and Derivatives This unit explains uniform continuity and its distinction from ordinary continuity. It also introduces the concept of derivatives and their role in analyzing the rate of change of functions.
Unit 12: Darboux Theorem and Applications This unit discusses Darboux theorem, which states that derivatives have the intermediate value property. It highlights its importance in understanding the behavior of differentiable functions.
Unit 13: Convergence of Function Sequences and Series This unit introduces sequences and series of functions, including pointwise and uniform convergence. It explains the M-test and presents key results related to uniform convergence.
Unit 14: Power Series and Convergence This unit focuses on power series and the concept of radius of convergence. It explains how power series represent functions and the conditions under which they converge.
Unit 15: Riemann Integration and Fundamental Theorem This unit introduces Riemann integration, including lower and upper Darboux sums and conditions for Riemann integrability. It explains primitive and indefinite integrals and presents the fundamental theorem of integral calculus, linking differentiation and integration.
PRACTICALS: Knowledge and use of various instrument. Geiger muller counter Scintillation counter survey meter single channel gamma spectrometer Cobalt camera. Linear Accelerator Finding out the operating voltage of the G-M tube Calculation of Inverse Square Law. Determination of the resolving time of the G-M tube. Absorption of beta and gamma rays. Determination of back scattering factors. Histopathological, histochemical and biochemical studies of various tissues after external irradiation. Decontamination of contaminated material. Visits to the Radiotherapy Department, S.M.S. Medical College, Jaipur

Suggested Books:

Malik S.C. and Arora S., (2017), Mathematical Analysis, New age International Publishers.
Bartle R. and Sherbert D.R., (2010), Introduction to Real Analysis, 4th Edition, John Wiley and Sons.
Ross K.A., (2013), Elementary Analysis: The Theory of Calculus, 2nd Edition, Springer New York Heidelberg Dordrecht London.
Ghorpade S.R. and Limaye B.V., (2006), A Course in Calculus and Real Analysis, Springer.

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Course Name: Data Base Management System	Course Code: UGCSA201
Semester: 3	Core / Elective: Core
Teaching Scheme in Hrs (L:T:P):	Credits: 4
Type of course: Lecture+ Assignments	Total Contact Hours:
Continuous Internal Evaluation:	ESE:

Course Outcomes: This course will enable the students to learn:

CO1. Understand and Explain Fundamental Concepts of Database Systems
CO2. Design and Model Data Using Entity-Relationship (ER) Diagrams
CO3. Formulate and Execute SQL and NoSQL Queries for Data Retrieval
CO4. Apply Normalization Techniques to Optimize Database Design
CO5. Implement Transaction Management and Concurrency Control Mechanisms

Unit 1: Fundamentals of Database Systems

This unit introduces database systems and their applications, highlighting the differences between database systems and traditional file systems. It explains data abstraction, instances, schemas, and the need for structured data management in modern applications.

Unit 2: Database Environment and Users

This unit focuses on database languages and the roles of various users such as database administrators, designers, and end users. It explains how different stakeholders interact with the database system.

Unit 3: Database Architecture and Components

This unit discusses the overall structure of a database system, including the storage manager and query processor. It also explains two-tier and three-tier architecture and their significance in database applications.

Unit 4: Basic Concepts of Data Modeling

This unit introduces fundamental concepts of data modeling, including design issues, mapping constraints, attributes, and entity sets. It explains how real-world entities are represented in databases.

Unit 5: Relationships and E-R Modeling

This unit focuses on relationships and relationship sets, keys, and entity-relationship diagrams. It also explains weak entity sets and their role in database design.

Unit 6: Advanced Data Models and NoSQL

This unit covers extended E-R features and introduces NoSQL data models. It highlights the need for flexible and scalable data modeling approaches in modern systems.

Unit 7: Introduction to Query Languages

This unit provides an overview of query languages, including SQL and NoSQL. It explains the structure of basic SQL queries and their role in data retrieval.

Unit 8: Advanced SQL Queries

This unit focuses on nested queries, subqueries, aggregate functions, and operators. It explains handling of NULL values and the use of logical and comparison operators in queries.

Unit 9: Join Operations and Query Optimization

This unit covers various join operations including inner joins, outer joins (left, right, full), cross joins, self joins, and natural joins. It also discusses complex integrity constraints and basic query optimization techniques.

Unit 10: Schema Design and Anomalies

This unit explains schema refinement and different types of anomalies in database design. It highlights the need for proper structuring of data to avoid redundancy and inconsistency.

Unit 11: Functional Dependency and Normalization This unit focuses on functional dependencies and normalization techniques including 1NF, 2NF, 3NF, and BCNF. It explains how normalization improves database design.
Unit 12: Advanced Normalization and Decomposition This unit discusses lossless join decomposition and dependency preservation. It also introduces multi-valued dependencies, join dependencies, and higher normal forms such as 4NF and 5NF.
Unit 13: Transaction Concepts and Properties This unit introduces transaction concepts, transaction states, and ACID properties. It explains schedules and the concept of serializability in database systems.
Unit 14: Concurrency Control Techniques This unit focuses on concurrency control mechanisms including locking protocols, timestamp ordering, and deadlock handling. It highlights techniques to ensure consistency in multi-user environments.
Unit 15: Recovery and Distributed Databases This unit explains recovery techniques such as log-based recovery and shadow paging. It also introduces the concept of distributed databases and their importance in modern systems.
List of Practical: Familiarization with SQL and Database Environment: Creating and managing databases and tables. SQL Queries: Writing SELECT queries with WHERE & ORDER BY clauses. Aggregative Functions: Using functions like COUNT, SUM, AVG, MIN, MAX. Joins in SQL: Implementing inner joins to retrieve data from multiple tables. Outer Joins: Implementing left joins and right joins to combine data. Handling NULL Values: Writing queries to handle NULL values using IS NULL and IS NOT NULL. Logical and Comparison Operators: Using logical operators (AND, OR) and comparison operators (=, <>, <, >). Integrity Constraints: Adding PRIMARY KEY and FOREIGN KEY to tables. Indexing: Creating simple indexes and observing performance improvement. Transactions and Normalization: Implementing basic transactions, ensuring ACID properties, and normalizing a database schema up to 3NF.

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Course Name: DEVELOPMENTAL BIOLOGY OF VERTEBRATES	Course Code: UGZOO201
Semester: 3	Core / Elective: Core
Teaching Scheme in Hrs (L:T:P):	Credits: 4
Type of course: Lecture+ Assignments	Total Contact Hours: 12
Continuous Internal Evaluation:	ESE:

Course Outcomes: Upon successful completion, the student will be able to

CO1: Understand the processes of gametogenesis, fertilization, and early embryonic development in vertebrates, including cleavage patterns, gastrulation, and neurulation in amphibians and mammals.

CO2: Analyze the molecular and cellular mechanisms of late embryonic development, such as implantation, placenta formation, and morphogenetic movements, to understand their roles in vertebrate ontogeny.

CO3: Apply knowledge of developmental genes and differential gene expression to elucidate the molecular basis of cell specification, differentiation, and morphogenesis in vertebrate development.

CO4: Evaluate the developmental genes regulation of metamorphic events and regeneration processes in vertebrates, such as amphibians and mammals, to assess their biological and environmental significance.

CO5: Assess the dynamics of organ development (e.g., eye, kidney, limb) and the biology of senescence to propose connections between developmental processes and aging in vertebrates.

Unit 1: Gametogenesis and Fertilization

Gametogenesis involves the formation of male and female gametes through spermatogenesis and oogenesis in mammals, ensuring genetic continuity. In birds, vitellogenesis is a crucial process involving yolk formation for embryonic nourishment. Fertilization may occur externally, as seen in amphibians, or internally in mammals. Mechanisms such as blocks to polyspermy ensure that only one sperm fertilizes the egg, maintaining chromosomal integrity and proper embryonic development.

Unit 2: Early Development and Cleavage Patterns

Early embryonic development includes the structure of the mature egg and its surrounding membranes, which provide protection and support. Cleavage patterns describe the series of mitotic divisions that transform the zygote into a multicellular structure. Fate maps help identify the future developmental potential of embryonic regions. Development proceeds up to the formation of the gastrula, a critical stage where the basic body plan is established.

Unit 3: Gastrulation, Germ Layers, and Neurulation

Gastrulation involves complex morphogenetic movements that lead to the formation of three primary germ layers—ectoderm, mesoderm, and endoderm—each giving rise to specific tissues and organs. The fate of these germ layers determines the structural organization of the organism. Neurulation in the frog embryo is a key process in which the neural tube forms, laying the foundation for the central nervous system.

Unit 4: Implantation, Placenta, and Metamorphosis

In humans, implantation is the process by which the embryo attaches to the uterine wall, followed by the formation of the placenta, which facilitates nutrient exchange and waste removal. Placenta types vary based on histological structure. In amphibians, metamorphosis represents a transition from larval to adult stages, regulated by hormonal mechanisms that control developmental changes.

Unit 5: Fundamental Processes in Development

Development is regulated by fundamental processes such as gene activation, determination, induction, and differentiation. These processes guide cells to acquire specific identities and functions. Morphogenesis shapes the organism through coordinated cell movements and structural changes, while intercellular communication ensures proper coordination among cells. Programmed cell death also plays a role in shaping tissues and removing unnecessary cells.

Unit 6: Cellular Mechanisms in Developmental Control Cell movements and interactions are essential for proper tissue formation and organ development. These processes are tightly regulated to ensure accurate spatial and temporal development. The integration of genetic and cellular mechanisms ensures the orderly progression of embryogenesis.
Unit 7: Gametogenesis and Fertilization Processes Gametogenesis and fertilization form the basis of early development, ensuring the combination of genetic material from both parents. The fertilized egg undergoes cleavage, leading to the formation of a multicellular embryo. These processes establish the initial stages of organismal development.
Unit 8: Cleavage, Gastrulation, and Fate Mapping Cleavage patterns determine the distribution of cells, while gastrulation reorganizes these cells into distinct germ layers. Fate maps provide insights into the developmental destiny of different regions of the embryo. These stages are essential for establishing the body plan and functional organization.
Unit 9: Cell Specification and Morphogenesis Developmental mechanics involve cell specification, where cells become committed to specific fates. Morphogenesis and cell adhesion play key roles in shaping tissues and maintaining structural integrity. These processes ensure coordinated development and proper formation of organs and systems.
Unit 10: Genes and Molecular Basis of Development Genes regulate development through controlled expression patterns that determine cellular behavior and differentiation. The molecular basis of development involves gene regulation mechanisms that influence growth and organization. Differential gene expression allows cells with identical genetic material to develop into diverse cell types.
Unit 11: Early Vertebrate Development Early development in vertebrates, including fish, birds, and mammals, follows similar fundamental principles but exhibits species-specific variations. These processes include fertilization, cleavage, and early tissue formation, contributing to the establishment of body structure.
Unit 12: Metamorphosis, Regeneration, and Environmental Regulation Metamorphosis involves significant structural and functional changes during development, while regeneration refers to the ability of organisms to repair or replace lost tissues. Stem cells play a crucial role in regeneration and development. Environmental factors also influence developmental processes, affecting growth and differentiation.
Unit 13: Organ Development and Differentiation Organogenesis involves the formation and development of organs such as the eye, kidney, and limbs. This process requires precise coordination of cell differentiation, growth, and spatial organization to ensure proper function.
Unit 14: Metamorphosis and Regeneration Metamorphosis in amphibians and insects is regulated by hormonal reactivation of developmental pathways, leading to transformation into adult forms. Regeneration is observed in organisms such as salamanders, hydras, and mammalian liver, demonstrating the capacity to restore damaged tissues through cellular and molecular mechanisms.
Unit 15: Aging and Senescence Aging is a biological process characterized by gradual decline in physiological function, known as senescence. It involves cellular and molecular changes that affect tissue function and organismal health. Understanding the biology of aging provides insights into longevity and age-related diseases.
PRACTICALS: Introduction to Medical Diagnostics and Methods Used for Analysis of Blood: Blood composition, Preparation of blood smear and Differential Leucocyte Count, (D.L.C) using Leishman's stain, Platelet count using hemocytometer, Erythrocyte Sedimentary Rate (E.S.R), Packed Cell Volume (P.C.V.) Diagnostic Methods Used for Urine Analysis: Physical characteristics; abnormal constituents. □ Introduction to haematology and blood sampling. □ Red blood cell count □ Estimation of haemoglobin concentration

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- White blood cell count
- Erythrocyte sedimentation rate (ESR)
- Anemia and red blood cells indices
- Reticulocyte count
- Preparation of blood Smear Platelet smear
- Gross match
- Clotting and bleeding time, Coombs test.

Suggested Books:

1) Gilbert, S. F. (2006). Developmental Biology, VIII Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA.
2) Balinsky, B.I. (2008). An introduction to Embryology, International Thomson Computer Press.
3) Kardong, K.V. (2005) Vertebrates' Comparative Anatomy, Function and Evolution. IV Edition. McGraw-Hill Higher Education.

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Course Name: PLANT TAXONOMY	Course Code: UGBOT201
Semester: 3	Core / Elective: Core
Teaching Scheme in Hrs (L:T:P):	Credits: 4
Type of course: Lecture+ Assignments	Total Contact Hours:
Continuous Internal Evaluation:	ESE:

Course Outcomes: Upon successful completion, the student will be able

CO1 Describe principles of plant systematics, classification systems, nomenclature, and supporting evidences.

CO2 Apply taxonomic concepts and rules to identify and classify plant taxa.

CO3 Analyze historical contributions and classification systems in angiosperm taxonomy.

CO4 Evaluate the role of taxonomic tools and phylogenetic methods in plant identification.

CO5 Design comparative taxonomic studies on selected angiosperm families.

Unit 1: Basics of Systematics and Plant Identification

Systematics deals with the study of diversity, identification, and classification of plants. Plant identification involves recognizing species based on morphological and other characteristics.

Unit 2: Classification and Nomenclature of Angiosperms

Classification systems such as Linnaeus, Bentham and Hooker, and Engler and Prantl provide frameworks for organizing angiosperms. Nomenclature ensures standardized naming of plants.

Unit 3: Evidences and Field Inventory

Systematics uses evidence from palynology, cytology, phytochemistry, and molecular data. Field inventory involves collection and documentation of plant diversity.

Unit 4: Concept of Taxa and Taxonomic Hierarchy

Taxa include categories like family, genus, and species arranged in a hierarchical system. These levels help in organizing plant diversity.

Unit 5: Species Concept

Different species concepts include taxonomic, biological, and evolutionary approaches, each explaining species classification based on different criteria.

Unit 6: Principles and Rules of Nomenclature (ICN)

The International Code of Nomenclature governs naming of plants. It includes rules on typification, author citation, valid publication, priority, rejection of names, and naming of hybrids.

Unit 7: Contributions of Botanists

Scientists like Theophrastus, Bauhin, Tournefort, Linnaeus, Adanson, de Candolle, Bessey, Hutchinson, Takhtajan, and Cronquist contributed to plant classification and taxonomy.

Unit 8: Classification Systems of Angiosperms

Bentham and Hooker and Engler and Prantl developed classification systems (up to series level) based on morphological features.

Unit 9: Modern Classification (APG III)

The Angiosperm Phylogeny Group (APG III) classification uses molecular data to provide a modern and phylogenetic system of classification.

Unit 10: Taxonomic Tools and Resources

Tools include herbarium, e-flora, botanical gardens, monographs, libraries, journals, keys, and illustrations for plant identification and study.

Unit 11: Important Herbaria and Botanical Gardens

Major herbaria and botanical gardens in India and the world serve as centers for plant collection, research, and conservation.

Unit 12: Methods of Studying Evolutionary Relationships Phylogenetic trees and cladograms are used to represent evolutionary relationships among plant groups.
Unit 13: Study of Selected Dicot Families Families such as Solanaceae, Convolvulaceae, Acanthaceae, Lamiaceae, Amaranthaceae, Euphorbiaceae, Ranunculaceae, Brassicaceae, Malvaceae, Rutaceae, Myrtaceae, Fabaceae, Apiaceae, Asteraceae, Apocynaceae, and Asclepiadaceae are studied for their characteristics and classification.
Unit 14: Study of Selected Monocot Families Monocot families such as Arecaceae, Liliaceae, Orchidaceae, and Poaceae are studied for their morphology and economic importance.
Unit 15: Economic and Systematic Importance of Families These plant families are important for agriculture, medicine, and industry, and their study helps in understanding plant diversity and classification.
PRACTICALS: Herbarium technique. Familiarity with local flora and preparation of herbarium sheet. Study of vegetative and floral characters of the following families (Description, V.S. flower, section of ovary, floral diagram/s, floral formula/e and systematic position according to Bentham & Hooker's system of classification- Ranunculaceae - *Ranunculus, Delphinium* Brassicaceae - *Brassica, Alyssum / Iberis* Asteraceae - *Sonchus/Launaea, Vernonia/Ageratum, Eclipta/Tridax* Solanaceae - *Solanum nigrum/Withania* Liliaceae - *Asphodelus/Lilium/Allium* Poaceae - *Triticum/Hordeum/Avena* Field visit (local) Identify plants by using taxonomic keys. Study of morphological adaptations of hydrophytes and xerophytes (four each). Study of biotic interactions of the following: Stem parasite (*Cuscuta*, Root parasite (Orobanche), Epiphytes, Predation (Insectivorous plants) Determination of minimal quadrat size for the study of herbaceous vegetation in the college campus by species area curve method.

Books Suggested:

Sharma, O.P. 1996. Plant Taxonomy. TATA McGraw Hill, New Delhi
Simpson, M.C. 2006. Plant Systematics. Elsevier, Amsterdam.
Singh, G. 2001. Plant systematics. Oxford and IBH, New Delhi.
Sivarajan, V.V. 1991. Introduction to Principles of Plant Taxonomy. Oxford and IB,New Delhi

Course Name: Lead Generation and Email Marketing	Course Code: UGLGEM
Semester: II	Core / Elective: Core
Teaching Scheme in Hrs (L:T:P):	Credits: 4
Type of course: Lecture+ Assignments	Total Contact Hours:
Continuous Internal Evaluation:	ESE:

Course Outcomes

CO1:Understand the fundamentals of lead generation, landing pages, and thank-you pages, and evaluate their role in converting prospects into potential customers.
CO2:Analyze different types of landing pages and apply A/B testing techniques to optimize conversion rates and improve marketing effectiveness.
CO3:Develop strategies for lead nurturing and understand the structure and stages of the lead funnel to convert leads into sales.
CO4:Explain the concepts, features, scope, benefits, and challenges of E-Marketing, and differentiate between internet marketing, digital marketing, and E-marketing.
CO5:Apply various E-Marketing techniques including online advertising, customer service mechanisms, relationship building, and distribution strategies to enhance business performance.
CO6:Design and implement E-Marketing tools such as websites, social media marketing, SEO, SEM, PPC advertising, blogging, and online marketplaces to execute effective digital campaigns.
Unit 1: Understanding Lead Generation for Business, Why Lead Generation is important, Understanding Landing Pages

Unit-2 : Understanding Thank You Page, Landing Page vs. Website, types of Landing Page.

Unit 3 :What is A/B Testing, how to do A/B Testing, selecting landing pages after A/B Testing, converting leads into sales

Unit 4 : creating lead nurturing strategy, Understanding lead funnel, Steps in lead nurturing.
Unit 5 :E-Marketing- Introduction, Objectives, Definition, History

Unit 6: Features of E-Marketing, Scope of E-Marketing, Benefits of E-Marketing

Unit 7: Problems in E-Marketing, E-marketing Techniques, Internet Marketing, Digital Marketing and E-marketing.

Unit 8:Online Advertising, Direct Response Medium, Role of Distribution in E-Marketing, Lead Generation, Platform

Unit:9 Customer Service Mechanism, Relationship Building Medium.

Unit 10:Types and Tools of E-Marketing, E-Malls, E-Storefront, E - Marketplace.

Unit 11:E-Marketing Tools: Creating a Website, Social Media Marketing,

Unit 12 Pay-Per Click Advertising, Search Engine Optimization or Paid Search Engine Listing, Search Engine Marketing, Blogging and Classified Advertising.

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Agarwal, V. (2019). Email Marketing Demystified: Build a Massive Mailing List, Write Copy that Converts and Generate More Sales (2nd ed.). Notion Press. ISBN: 978-1648500007.
Sinha, S. (2020). Lead Generation Mastery: The Beginner's Guide to Capturing Leads Online. Notion Press. ISBN: 978-1648504579.
Sharma, R. K., & Singh, A. (2018). Email Marketing: Strategies to Capture and Engage Your Audience, While Quickly Building an Authority (2nd ed.). Independently published. ISBN: 978-1718029403.
Patel, N. (2021). Lead Generation Blueprint: Strategies for Online Marketers. Notion Press. ISBN: 978-1649831902.
Gupta, R., & Verma, S. (2022). Email Marketing Mastery: Build Your List and Generate Revenue. Notion Press. ISBN: 978-1684662164

Course Name: Foundation to Entrepreneurship	Course Code: UGFTE
Semester: III	Core / Elective: Core
Teaching Scheme in Hrs (L:T:P):	Credits: 2
Type of course: Lecture+ Assignments	Total Contact Hours:
Continuous Internal Evaluation:	ESE:

Course Outcomes
CO1:Identify and evaluate entrepreneurial opportunities through environmental scanning, idea classification, and market assessment techniques. CO2:Analyze business concepts using tools such as value proposition, market segmentation, product life cycle, BCG matrix, and SWOT analysis for effective decision-making. CO3:Develop a comprehensive business plan including market, financial, operational, and human resource components for a startup venture. CO4:Apply entrepreneurial skills to transform ideas into viable ventures by creating MinimumViable Products (MVPs), addressing startup challenges, and presenting structured business plans.
Unit 1: Identification and classification of ideas. Entrepreneurial opportunities, environment scanning, Market assessment.
Unit 2 :Value Proposition, Product and Service; Market segmentation, Product Life cycle; BCG Matrix, Environmental Scanning and SWOT analysis
Unit 3: Components of an ideal business plan – market plan, financial plan, operational plan, and HR plan.
Unit 4: Concept to Creation, Minimum Viable Product (MVP), Teething Problems of startup
Unit 5:. Organizing and Marketing a Startup Selling on the web, launching e-commerce, Starting and growing an Enterprise, Growth Path
Unit 6: Students have to prepare a detailed business plan selecting a product(s), Presentation of such business plans and submission after necessary corrections suggested by subject faculty
References: Online Courses through MOOC, Classroom learning through an experienced Facilitator/Faculty on campus (Games, Exercises, Videos, and Practical Experiences)
1. Tendon ,C: Environment and Entrepreneur; Cliugh Publications, Allahabad. 2. Siner A David: Enterpreneural Megabuks; John Wiley and Sons, New York. 3. Srivastava S. B: A Practical Guide to Industrial Entrepreneurs; Sultan Chand and Sons, New Delhi. 4. Prasanna Chandra: Protect Preparation, Appraisal, Implementation; Tata McGraw Hill. New Delhi. 5. Paudey I.M: Venture Capital - The Indian Experience; Prentice Hall of India. New Delhi 6. Holt: Entrepreneurship-New Venture Creation; Prentice Hall of India. New Delhi

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Course Name: New Media & Digital Promotion	Course Code: UGNMDP
Semester: III	Core / Elective: Core
Teaching Scheme in Hrs (L:T:P):	Credits: 4
Type of course: Lecture+ Assignments	Total Contact Hours:
Continuous Internal Evaluation:	ESE:

Course outcome: CO1: To understand social media and social media marketing. CO2: To understand digital marketing platforms. CO3: To learn the analytics of digital media. CO4: To learn the techniques of branding on social media platforms. CO5: To learn social media measurement and metrics.
Unit 1: Introduction to New Media and Journalism The 24/7 media concepts, web publishing tools and applications, convergence of technologies, global and Indian scenario, online journalism business model.
Unit 2 New Tools of Journalism Web newspapers, blogs, vlogs and blog aggregators, integrated newsroom, multi-platform content management, internet research, audio and video.
Unit 3: Online Writing and Editing Elements of writing for web newspapers, websites and portals. Differences and similarities with print media, effective blog writing, developing and editing content and stories for the web, file transfer protocols and uploading images and text, creating graphics and animation, introduction to website designing applications.
Unit 4: Web Broadcasting Global scene of web broadcasting, basics of TV and radio on the internet, web TV and web radio as advertising and PR tools, news and feature writing formats for web radio and web TV.
Unit 5: Technology & Society Access and digital divide, cyberspace and the public sphere, digital natives and digital immigrants, impact of digital technology on culture, digital media activism, participatory communication, citizen journalism, fan culture in new media.
Unit 6 Trends in Communication Technology Mediated communication, social consequences of new communication technology, mobile phones and micro-cultures, adoption and use of technologies, media convergence, digital media literacy, production and consumption in the digital age.
Unit 7 : Evolution of Digital Media and Digital Communication Online communication, online communities, online identities, social networking and social media tools, human-computer interaction, social interactions and mobile phones/internet.
Unit 8: Digital Storytelling Tools of multimedia journalists, learning to report, write and produce in a manner appropriate for online media,feature writing for online media: story idea, development, and news updates, podcasting and webcasting.
Unit 9: Open Source Journalism Responding to the audience, annotative reporting, citizen journalists, problems of verification, accuracy and fairness, use of blogs, tweets, etc. for story generation and development, protecting copyright.
Unit 10: New Media

Convergence: need, nature, and future of convergence, emerging trends: mobile technology, social media & web,2.0, participatory journalism: traditional and contemporary meaning.
Unit 11: Online Journalism Traditional vs. online journalism - differences in news consumption, types of journalism online: blogs, news websites, citizen journalism, online writing & editing: do's and don'ts.
Unit 12: Principles of New Media Introduction, principles of new media, functions, impact of new media on society, traditional media vs. new media, e-society: governance, commerce, education, and new media communication.
Unit 13 Online Journalism, Cyber Law and Ethics Traditional vs. pen-less/paperless journalism, news and content presentation, do's and don'ts for reporting and editing for e-papers, websites, and news portals, cyber crimes and cyber security: an overview, IT Act (2000), ethics and limitations: piracy, copyright, copyleft, open source, digital archives.
Unit 14 New Media: Issues & Applications Digital divide and information society, ICT and its applications and e-governance, convergence and its types: synergy between electronic and mobile commerce, social media platforms: importance and usage.

Reference Books:

- Pandey, Sudhir. 2000. Handbook of Satellite Communication. Authors Press, New Delhi.
- Jenkins, Henry. 2006. Fans, Bloggers, and Gamers – Media Consumers in a Digital Age. New York University Press.
- Bruns, Alex. 2005. Gatewatching – Collaborative Online News Production. Peter Lang.
- Ling, Rich. 2004. The Mobile Connection – The Cell Phone's Impact on Society. Morgan Kaufmann.
- Manovich, Lev. 2002. The Language of New Media. MIT Press, Cambridge, England.

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Course Name: Algebra	Course Code: UGMAT211
Semester: 4	Core / Elective: Core
Teaching Scheme in Hrs (L:T:P):	Credits: 4
Type of course: Lecture+ Assignments	Total Contact Hours: 12
Continuous Internal Evaluation:	ESE:

Course Outcomes: The course will enable the students to:
CO1: Explain the fundamental concepts of groups, including abelian and non-abelian structures, cyclic groups, and permutation groups, using standard algebraic notations and properties.
CO2: Apply group-theoretic concepts such as subgroups, cosets, Lagrange's theorem, and cyclic properties to solve algebraic problems.
CO3: Analyze algebraic structures using homomorphisms, normal subgroups, and quotient groups, and demonstrate the application of the First Isomorphism Theorem and Cayley's Theorem.
CO4: Differentiate between rings, integral domains, and fields through examples and identify substructures such as subrings and subfields using their defining properties.
CO5: Interpret abstract algebraic principles in the context of mathematical problem-solving and construct proofs involving group and ring theoretic identities and structures.

Unit 1: Definition and Examples of Groups
This unit introduces the concept of a group, including its definition and fundamental properties. It provides examples of groups to illustrate the abstract concept and explains the distinction between abelian and non-abelian groups based on the commutativity of the group operation.

Unit 2: Special Groups and Orders
This unit focuses on the group (\mathbb{Z}_n) of integers under addition modulo (n). It explains the concept of the order of a group and the order of an element, along with their basic properties. These concepts are essential for understanding the structure of finite groups.

Unit 3: Fundamental Properties of Groups
This unit discusses important properties of groups, including identity, inverses, and closure. It emphasizes the role of these properties in establishing the algebraic structure of groups and solving problems related to group theory.

Unit 4: Cyclic Groups and Their Properties
This unit introduces cyclic groups and explains how they are generated by a single element. It discusses their properties, structure, and significance in simplifying the study of groups.

Unit 5: Permutation Groups and Cycles
This unit explains permutation groups as groups of rearrangements of elements. It introduces cycles and transpositions, providing a systematic way to represent permutations and analyze their structure.

Unit 6: Symmetric and Alternating Groups
This unit focuses on symmetric groups and alternating groups, explaining their definitions, properties, and importance in group theory. These groups serve as key examples in abstract algebra.

Unit 7: Subgroups and Generated Subgroups
This unit introduces subgroups and explains how subsets of a group can form subgroups. It includes the concept of subgroups generated by a subset and the commutator subgroup, along with relevant examples.

Unit 8: Special Subgroups and Their Properties
This unit discusses important subgroups such as the center of a group and the centralizer of a group. It explains their definitions and significance in understanding group structure.

Unit 9: Cosets and Lagrange's Theorem
This unit introduces cosets and explains the concept of index of a subgroup. It presents Lagrange's

theorem and its implications for finite groups, highlighting the relationship between subgroup order and group order.
Unit 10: Homomorphism of Groups and Properties This unit explains group homomorphisms, including their definition and fundamental properties. It highlights how structure-preserving maps help relate different groups.
Unit 11: Cayley's Theorem and Normal Subgroups This unit introduces Cayley's theorem and explains its significance in representing groups as permutation groups. It also discusses normal subgroups, including their definition, examples, and characterizations.
Unit 12: Quotient Groups and Their Structure This unit focuses on quotient groups formed using normal subgroups. It explains their construction and importance in simplifying group structures and studying group properties.
Unit 13: Definition and Examples of Rings This unit introduces rings and provides examples of commutative and non-commutative rings. It explains the basic properties that define ring structures.
Unit 14: Fields and Integral Domains This unit discusses fields and integral domains, including their definitions and properties. It highlights the differences between these algebraic structures and their importance in mathematics.
Unit 15: Subrings and Subfields This unit explains subrings and subfields, including their definitions and properties. It emphasizes how smaller algebraic structures can be derived from larger ones while preserving essential characteristics.
Suggested Books: 1. Gallian J.A., (1999), Contemporary Abstract Algebra, 4th Edition, Narosa Publishing House, New Delhi. 2. Fraleigh J.B., (2002), A First Course in Abstract Algebra, 7th Edition, Pearson Education, Asia. 3. Artin M., (2011), Abstract Algebra, 2nd Edition, Pearson Education, Asia. 4. Rotman J.J., (1995), An Introduction to the Theory of Groups, 4th Edition, Springer Verlag.

Course Name: Wave Optics	Course Code: UGPHY211
Semester: 4	Core / Elective: Core
Teaching Scheme in Hrs (L:T:P):	Credits: 4
Type of course: Lecture+ Assignments	Total Contact Hours: 12
Continuous Internal Evaluation:	ESE:

Course Outcomes:
CO1: Understand and explain the electromagnetic nature of light, coherence, and interference phenomena using wave superposition principles.
CO2: Apply and analyze interferometric techniques (Michelson and Fabry-Perot) to measure wavelength, refractive index, and resolve fringe patterns
CO3: Analyze and derive diffraction patterns for various apertures and gratings, and evaluate intensity distributions and resolution limits.
CO4: **Evaluate and explain** resolving power of optical instruments and understand various methods of producing and analyzing polarized light.
CO5: **Apply and interpret** the concepts of optical activity and matrix methods (Jones calculus) to describe and analyze polarization transformations.

Unit 1: Nature of Light and Coherence
This unit explains the electromagnetic nature of light and the principle of superposition of light waves. It introduces the concepts of coherence, including spatial and temporal coherence, and their importance in producing stable interference patterns.

Unit 2: Interference by Division of Wavefront
This unit covers interference phenomena arising from division of wavefront, including Young's double slit experiment, Fresnel's biprism, and Lloyd's mirror. It explains the formation of interference fringes and the conditions required for constructive and destructive interference.

Unit 3: Interference by Division of Amplitude
This unit discusses interference due to division of amplitude, focusing on thin films such as parallel and wedge-shaped films, and Newton's rings. It explains the formation of fringes and their applications in determining wavelength and thickness.

Unit 4: Michelson Interferometer and Fringe Formation
This unit introduces the Michelson interferometer and explains the basic idea of fringe formation. It highlights the working principle and conditions affecting fringe visibility.

Unit 5: Applications of Michelson Interferometer
This unit explains the use of the Michelson interferometer in determining wavelength, wavelength difference, and refractive index. It also discusses the concept of visibility of fringes and its significance.

Unit 6: Fabry–Perot Interferometer and Etalon
This unit covers the Fabry–Perot interferometer and etalon, explaining their construction, working, and applications in producing sharp interference fringes for precise measurements.

Unit 7: Fresnel Diffraction
This unit introduces Fresnel diffraction and explains half-period zones and zone plates. It also covers diffraction at a straight edge and narrow wire, emphasizing near-field diffraction phenomena.

Unit 8: Fraunhofer Diffraction and Intensity Distribution
This unit discusses Fraunhofer diffraction at circular apertures and single and double slits. It includes the derivation of equations for intensity distribution and explains the concept of visibility of fringes.

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Unit 9: Diffraction Grating and Spectral Analysis This unit focuses on diffraction grating, explaining principal maxima, missing orders, and its applications in spectral analysis and wavelength determination.
Unit 10: Resolving Power and Rayleigh Criterion This unit explains the concept of resolving power and Rayleigh's criterion of resolution. It discusses the resolving power of optical instruments such as gratings and telescopes.
Unit 11: Polarization of Light and Laws This unit introduces polarization by reflection and explains Brewster's law and polarizing angle. It also covers the law of Malus and the basic principles governing polarized light.
Unit 12: Optical Devices for Polarization This unit discusses polarization by dichroic crystals and birefringence in anisotropic crystals. It explains the construction and working of Nicol prism, retardation plates, and Babinet compensator, along with methods for analyzing polarized light.
Unit 13: Optical Activity and Fresnel's Explanation This unit introduces optical activity and explains Fresnel's theory behind it. It discusses the concept of specific rotation and its significance in studying optically active substances.
Unit 14: Polarimeters and Measurement Techniques This unit explains the working principles of half-shade and biquartz polarimeters used for measuring optical rotation. It highlights their applications in chemical and biological analysis.
Unit 15: Jones Matrix and Polarization Analysis This unit introduces the Jones matrix method and explains the matrix representation of plane polarized waves. It includes matrices for polarizers, retardation plates, and rotators, emphasizing their use in analyzing polarized light systems.
Practical's: 1. Measurement of Dispersive power of a given prism using Mercury Light 2. Determination of the wavelength of light by Newton's ring. 3. Verification of Brewster's Law 4. Determination of specific rotation of an optically active substance by polarimeter 5. To determine the Refractive Index of the Material of a given Prism using Sodium Light. 6. To determine the value of Cauchy Constants of a material of a prism. 7. To determine the Resolving Power of a Prism. 8. To determine wavelength of sodium light using Fresnel Biprism.
Suggested Books: 1. Physics of Light and Optics, Michael Ware, Justin Peatross, 2015 2. Brij Lal and N. Subrahmaniyam, Optics, S. Chand, 2012 3. E.Hecht, Optics, Pearson, 2019 4. A.K.Ghatak, Optics, Tata Mc Graw Hill, 2009. Digital References: **https://archive.nptel.ac.in/courses/115/107/115107131/** **https://archive.nptel.ac.in/courses/115/107/115107131/**

Course Name: Industrial Inorganic Chemistry	Course Code: UGCHM211
Semester: 4	Core / Elective: Core
Teaching Scheme in Hrs (L:T:P):	Credits: 4
Type of course: Lecture+ Assignments	Total Contact Hours: 12
Continuous Internal Evaluation:	ESE:

Course Outcomes:
CO1: Student will be able to understand the principle of glass industry.
CO2: Student will be able to compare about the basics chemistry behind cement and ceramics industries.
CO3: Student will be able to understand the basic chemical principles of industrial paint.
CO4: Student will be able to learn about fertilizers and their manufacturing.
CO5: Student will be able to analyze the fundamentals of corrosion & perform analysis of cement and estimate
calcium.

Unit 1: Glass and Silicate Materials
This unit introduces inorganic materials such as alumina, silicates, glass, clays, cement, mica, and zeolites with emphasis on their industrial relevance. It explains the concept of the glassy state and its unique properties, along with classification into silicate and non-silicate glasses. The processes involved in the manufacture and processing of glass are also discussed, highlighting their practical applications.

Unit 2: Ceramics and Clay Materials
This unit focuses on ceramics and their raw materials, particularly important clays and feldspar. It covers the classification and types of ceramics along with their manufacturing processes. The role of structural composition and firing techniques in determining ceramic properties is also explained.

Unit 3: Cement and Its Composition
This unit deals with cement as a crucial construction material. It includes classification of different types of cement, the ingredients used in its preparation, and the specific roles played by each component. The relationship between composition and performance characteristics of cement is emphasized.

Unit 4: Classification and Types of Alloys
This unit introduces alloys and their classification into ferrous and non-ferrous categories. It discusses the characteristics and applications of each type along with the role of alloying elements in modifying properties such as strength, hardness, and corrosion resistance.

Unit 5: Properties of Alloying Elements
This unit explains the specific properties contributed by different elements when added to alloys. It highlights how alloy composition influences mechanical and chemical behavior, thereby determining industrial suitability.

Unit 6: Manufacture and Types of Steel
This unit focuses on the manufacturing processes of steel and the composition of different types of steels. It explains how variations in composition affect properties and uses of steel in various industrial applications.

Unit 7: Paints and Their Composition
This unit covers the basic concept of paints, including ingredients and their specific functions. It explains the essential properties of paints and the processes involved in their manufacture, along with the importance of eco-friendly paints.

Unit 8: Enamels and Emulsifying Agents
This unit discusses enamels and their characteristics, along with the role of emulsifying agents in

paint formulations. It highlights their importance in improving stability, finish, and performance of coatings.
Unit 9: Surface Coatings and Protective Methods This unit focuses on the objectives of surface coatings and their role in protection. It includes an introduction to metallic coatings, electroplating processes, and cleaning methods used before coating to ensure effectiveness and durability.
Unit 10: Basic Metallurgical Operations This unit explains fundamental metallurgical operations such as pulverization, calcination, roasting, and refining of metals. It highlights their significance in the extraction and purification of metals.
Unit 11: Extraction of Metals This unit discusses the physicochemical principles involved in the extraction of important metals such as iron, copper, and silver. It emphasizes the stepwise processes and reactions involved in obtaining pure metals from ores.
Unit 12: Corrosion and Its Control This unit introduces corrosion, its economic impact, and different types including dry (chemical) and wet (electrochemical) corrosion. It explains the mechanism of electrochemical corrosion and various methods used for its prevention and control.
Unit 13: Types of Fertilizers This unit introduces fertilizers and their importance in agriculture. It explains different types of fertilizers based on composition and usage.
Unit 14: Manufacture of Nitrogenous Fertilizers This unit focuses on the manufacturing processes of nitrogen-based fertilizers such as urea and ammonium nitrate. It highlights the chemical reactions and industrial methods involved.
Unit 15: Phosphatic and Mixed Fertilizers This unit discusses the manufacture of ammonium phosphates and mixed fertilizers. It explains their composition, preparation, and role in enhancing soil fertility and crop productivity.

Suggested Books:

1.E. Stocchi: Industrial Chemistry, Vol-I, Ellis Horwood Ltd. UK.
2.E. Stocchi: Industrial Chemistry, Vol-II, Ellis Horwood Ltd. UK.
3.R. M. Felder, R. W. Rousseau: Elementary Principles of Chemical Processes, Wiley Publishers, New Delhi.
4.W. D. Kingery, H. K. Bowen, D. R. Uhlmann: Introduction to Ceramics,Wiley Publishers, New Delhi.
5.J. A. Kent: Riegel's Handbook of Industrial Chemistry, CBS Publishers, New Delhi, 1997.
6.P. C. Jain & M. Jain: Engineering Chemistry, DhanpatRai& Sons, Delhi.
7.R. M. Felder, R. W. Rousseau: Elementary Principles of Chemical Processes, Wiley Publishers, New Delhi.
8/W. D. Kingery, H. K. Bowen, D. R. Uhlmann: Introduction to Ceramics,Wiley Publishers, New Delhi.

Digital References:

1.https://faculty.ksu.edu.sa/sites/default/files/industrial_inorganic_chemistry_chem427_for_print.pdf
2.**https://youtu.be/3He784vumas**

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Course Name: Object- Oriented Programming using JAVA	Course Code: UGCSA117
Semester: 4	Core / Elective: Core
Teaching Scheme in Hrs (L:T:P):	Credits: 4
Type of course: Lecture+ Assignments	Total Contact Hours:
Continuous Internal Evaluation:	ESE:

Course Outcomes:
CO1: Understand and implement fundamental OOP techniques and data types, variables, constants, assignments, expressions, and operators of Java programming language.
CO2: Understand and implement selection statements, loops, mathematical functions, and strings.
CO3: Understand and implement methods, arrays and recursion using Java.
CO3: Understand and implement object-oriented paradigm using abstraction, encapsulation, inheritance, and polymorphism.
CO5: Understand and implement the inheritance, exception handling, abstract classes, interfaces, Text I/O and binary I/O.

Unit 1: Basics of Java Programming Environment
This unit introduces object-oriented programming concepts and the Java programming environment, including the Java Language Specification, API, JDK, and IDE. It explains the process of creating, compiling, and executing Java programs and developing applications using tools such as NetBeans or Creator.

Unit 2: Variables, Identifiers and Data Types
This unit covers identifiers, variables, assignment statements, assignment expressions, and named constants. It explains naming conventions, numeric data types, numeric literals, and various operations associated with them.

Unit 3: Expressions and Type Conversions
This unit focuses on evaluating expressions, operator precedence, increment and decrement operators, and numeric type conversions. It highlights how expressions are processed and optimized in Java programs.

Unit 4: Selection Statements and Logical Operations
This unit explains Boolean data types and control structures such as if, if-else, nested if, and multi-way if-else statements. It also covers logical operators, switch statements, conditional expressions, and operator precedence and associativity.

Unit 5: Character and String Handling
This unit introduces character data types and operations along with the String type. It explains manipulation and usage of characters and strings in Java programming.

Unit 6: Looping Constructs
This unit covers looping mechanisms including while, do-while, and for loops. It also explains nested loops and the use of break and continue statements for flow control.

Unit 7: Methods and Modular Programming
This unit explains defining and calling methods, passing arguments by value, and modularizing code. It also covers method overloading, scope of variables, and concepts of method abstraction and stepwise refinement.

Unit 8: Arrays and Multidimensional Structures
This unit introduces array basics, copying arrays, passing arrays to methods, and returning arrays from methods. It also includes searching and sorting arrays along with two-dimensional and multidimensional arrays.

Unit 9: Recursion in Java This unit focuses on recursion, explaining its concept and implementation in Java. It highlights writing recursive programs and comparing them with iterative approaches.
Unit 10: Class Design and Core Object Concepts This unit introduces class abstraction and encapsulation, emphasizing thinking in objects. It explains handling primitive data types as objects and discusses classes such as BigInteger, BigDecimal, and String.
Unit 11: Inheritance and Polymorphism This unit explains superclass and subclasses, use of the super keyword, method overriding, and differences between overriding and overloading. It also covers polymorphism and dynamic binding.
Unit 12: Object Handling and Collections This unit discusses object casting, the instanceof operator, the Object class and its toString() and equals() methods. It also introduces the ArrayList class and its role in dynamic data handling.
Unit 13: Exception Handling and Abstract Concepts This unit explains exception handling, types of exceptions, and the finally clause. It includes defining custom exception classes and introduces abstract classes, interfaces, and the Comparable interface, along with differences between interfaces and abstract classes.
Unit 14: File Handling and Generics This unit covers text I/O handling in Java, differences between text and binary I/O, and binary I/O classes. It also introduces generic classes, generic interfaces, and generic methods, highlighting their benefits.
Unit 15: Multithreading and Applets This unit explains processes and threads, thread creation and management, including sleep, interrupts, join, and synchronization. It also introduces applet fundamentals and the design and development of Java applets.
List of Practicals: Program in Java to design simple calculator for (+, -, *, and /) using switch case Program in Java to design accounts class and two functions withdraw () and deposit (). Program in Java to search a particular element in a one-dimensional array. Program in Java to the concept of polymorphism by designing functions to sum different type of numbers Program to show the concept of method overriding in Java. Program in Java that import the user define package and access the Member variable of classes that Contained by Package. Program in Java to handle the Exception using try and multiple catch block. Program in Java demonstrating text I/O and binary I/O. Program in Java using multi-threading. Program in Java demonstrating Applet

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Course Name: MOLECULAR BIOLOGY	Course Code: UGZOO211
Semester: 4	Core / Elective: Core
Teaching Scheme in Hrs (L:T:P):	Credits: 4
Type of course: Lecture+ Assignments	Total Contact Hours: 12
Continuous Internal Evaluation:	ESE:

Course Outcomes: Upon successful completion, the student will be able to
CO1: Understand the fundamental structure, types, and organization of nucleic acids (DNA and RNA), including their higher-order chromatin structures in prokaryotic and eukaryotic organisms.
CO2: Explain the core principles of genetic information flow, including the Central Dogma of molecular biology and the key features of the genetic code.
CO3: Illustrate the various models, mechanisms, and key enzymes involved in DNA replication in different organisms, including the replication of linear chromosomes.
CO4: Explain the process of transcription in prokaryotes and eukaryotes, including the principles of transcriptional regulation and the different types of RNA processing and modification.
CO5: Elaborate on the detailed steps of protein synthesis (translation), including ribosome assembly, polypeptide elongation and termination, and the subsequent post-translational modifications of proteins.

Unit 1: DNA as Genetic Material and Central Dogma

Nucleic acids serve as carriers of genetic information, with DNA being the primary genetic material in most organisms. Key experiments established DNA as the hereditary molecule and led to the formulation of the central dogma, which describes the flow of genetic information from DNA to RNA to protein. This framework is fundamental to understanding molecular biology and gene expression.

Unit 2: DNA Structure and Types

The structure of DNA evolved through scientific discoveries from Miescher to Watson and Crick, culminating in the double helix model. The DNA molecule consists of two antiparallel strands held together by complementary base pairing. Various types of DNA exist based on structural variations. The organization of DNA differs among prokaryotes, viruses, and eukaryotes, reflecting differences in complexity and packaging.

Unit 3: Organelle DNA and Genome Organization

In addition to nuclear DNA, genetic material is also present in organelles such as mitochondria and chloroplasts. These organelle DNAs have distinct characteristics and play important roles in cellular function. Genome organization involves efficient packaging and regulation of DNA within cells, ensuring proper replication and expression.

Unit 4: RNA Structure and Types

RNA is a single-stranded nucleic acid involved in various cellular functions, including protein synthesis and regulation. Different types of RNA, such as messenger RNA, transfer RNA, and ribosomal RNA, perform specialized roles in gene expression. The structure of RNA enables it to participate in diverse biological processes.

Unit 5: Chromatin Structure and Nucleosome Organization

Chromatin is composed of DNA and proteins and exists in two forms: euchromatin, which is transcriptionally active, and heterochromatin, which is condensed and less active. Heterochromatin can be constitutive or facultative based on its functional state. The nucleosome is the basic unit of chromatin organization, and its assembly and regulation are essential for controlling gene accessibility and expression.

Unit 6: Chromosome Organization and Genetic Code

Chromosomes are organized structures of DNA that ensure accurate distribution of genetic material during cell division. The genetic code is a set of rules that defines how nucleotide sequences are

translated into amino acids. Its deciphering revealed key features such as universality, degeneracy, and specificity, which are fundamental to protein synthesis.
Unit 7: Principles and Mechanisms of DNA Replication DNA replication is the process by which genetic material is duplicated before cell division. It follows general principles such as being bidirectional, semiconservative, and semidiscontinuous. RNA priming is essential for initiating replication, and various models, including rolling circle and theta replication, explain different replication mechanisms.
Unit 8: Replication of Different DNA Forms Replication mechanisms vary depending on the structure of DNA, including circular and linear DNA. Special mechanisms are required for the replication of linear double-stranded DNA, particularly at the 5' end of chromosomes. These adaptations ensure complete and accurate duplication of genetic material.
Unit 9: Enzymes and Proteins in DNA Replication DNA replication involves several enzymes and accessory proteins. DNA polymerases synthesize new DNA strands, DNA ligase joins fragments, primase synthesizes RNA primers, and telomerase maintains chromosome ends. These components work together to ensure high fidelity and efficiency of replication.
Unit 10: Transcription in Prokaryotes and Eukaryotes Transcription is the process of synthesizing RNA from a DNA template. It occurs in both prokaryotes and eukaryotes, with differences in regulatory mechanisms and complexity. Principles of transcriptional regulation control gene expression. In prokaryotes, regulation of lactose metabolism and tryptophan synthesis in E. coli serves as classic examples of gene regulation.
Unit 11: RNA Processing and Splicing Mechanisms RNA processing involves the conversion of primary transcripts into functional RNA molecules. This includes the removal of introns and joining of exons through splicing. Different splicing pathways, including group I and group II intron splicing and alternative splicing, contribute to protein diversity. RNA editing further modifies RNA sequences to produce functional transcripts.
Unit 12: mRNA Modification and Maturation Messenger RNA undergoes modifications such as addition of a 5' cap and a 3' poly-A tail, which enhance stability and translation efficiency. These processes are essential for proper gene expression and regulation in eukaryotic cells.
Unit 13: Ribosome Structure and Initiation of Translation Translation is the process of protein synthesis, where ribosomes play a central role by interacting with mRNA. Ribosome structure and assembly are crucial for initiating translation. The initiation phase involves the assembly of ribosomal subunits and binding of mRNA and initiator tRNA.
Unit 14: Elongation, Termination, and Fidelity of Translation During elongation, amino acids are added sequentially to the growing polypeptide chain. Termination occurs when a stop codon is reached. Fidelity of translation ensures accurate protein synthesis. Various inhibitors can interfere with translation, affecting protein production.
Unit 15: Post-Translational Modifications of Proteins After synthesis, proteins undergo post-translational modifications such as folding, cleavage, and addition of functional groups. These modifications are essential for achieving proper structure and biological activity of proteins.
Practicals: 1. Preparation of LB medium and raising E.Coli. 2. Demonstration of mammalian sex chromatin. 3. Isolation of genomic DNA from E.Coli. 4. DNA isolation from cauliflower head. 5. DNA estimation by diphenylamine reagent/UV Spectrophotometry. 6. Study of DNA replication mechanisms through photographs (Rolling circle, Theta replication and semi-discontinuous replication). 7. Study of structures of prokaryotic RNA polymerase and eukaryotic RNA polymerase II through photographs. 8. Study of the following through photographs: Assembly of Spliceosome machinery; Splicing

mechanism in group I & group II introns; Alternative splicing.

Suggested Books:

1) Watson J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M., Losick, R. (2007). MolecularBiology of the Gene, Pearson Benjamin Cummings, CSHL Press, New York, U.S.A. 6 th edition

2) Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics. John Wiley and Sons Inc.,U.S.A. 5th edition.

3) Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. Benjamin

4) Russell, P. J. (2010). i-Genetics- A Molecular Approach. Benjamin Cummings, U.S.A.

Course Name: APPLIED TECHNIQUES IN PLANT SCIENCES	Course Code: UGBOT211
Semester: 4	Core / Elective: Core
Teaching Scheme in Hrs (L:T:P):	Credits: 4
Type of course: Lecture+ Assignments	Total Contact Hours:
Continuous Internal Evaluation:	ESE:

Course Outcomes:

CO1 Describe the principles and applications of microscopy and fluorescence-based imaging techniques in biological research.

CO2 Apply cell fractionation and centrifugation techniques to isolate and study cellular components.

CO3 Analyze the role of radioisotopes and spectrophotometric methods in biological investigations.

CO4 Evaluate different chromatographic techniques for their effectiveness in biomolecule separation.

CO5 Design experimental approaches using protein and nucleic acid characterization techniques such as electrophoresis, X-ray crystallography, and mass spectrometry.

Unit 1: Principles of Microscopy and Light Microscopy

Microscopy is used to study structures that are not visible to the naked eye. Light microscopy is based on visible light and lenses to magnify specimens and observe cellular details.

Unit 2: Advanced Microscopy Techniques

Fluorescence and confocal microscopy use fluorochromes to visualize specific structures. Applications include chromosome banding, FISH, and chromosome painting. Electron microscopy includes transmission and scanning types for high-resolution imaging.

Unit 3: Flow Cytometry and Fluorochrome Applications

Flow cytometry (FACS) uses fluorescent markers to analyze and sort cells. Fluorochromes help in identifying cellular components and studying biological processes.

Unit 4: Principles of Centrifugation

Centrifugation separates cellular components based on size and density. Differential centrifugation is used for basic separation.

Unit 5: Density Gradient and Advanced Centrifugation

Density gradient centrifugation includes sucrose and $CsCl_2$ gradients for precise separation. Analytical centrifugation and ultracentrifugation provide detailed analysis.

Unit 6: Marker Enzymes and Applications

Marker enzymes are used to identify specific cell organelles during fractionation. These techniques are essential for studying cell structure and function.

Unit 7: Radioisotopes and Their Applications

Radioisotopes are used in biological research for tracing molecules. Techniques include autoradiography and pulse-chase experiments.

Unit 8: Spectrophotometry and Colorimetry

Spectrophotometry measures light absorption to analyze biological samples. Colorimetry is used for concentration estimation but has certain limitations.

Unit 9: Atomic Absorption Spectroscopy (AAS)

AAS measures the concentration of metal ions in biological samples and is widely used in research and environmental studies.

Unit 10: Principles and Basic Chromatography Methods

Chromatography separates components based on their movement through a stationary and mobile phase. Paper chromatography and column chromatography are basic methods.

Unit 11: Advanced Chromatography Techniques Techniques such as TLC, GLC, HPLC, and ion-exchange chromatography allow precise separation and analysis of compounds.
Unit 12: Specialized Chromatography Methods Molecular sieve and affinity chromatography are used for separating molecules based on size and specific binding properties.
Unit 13: Spectroscopic and Structural Techniques Mass spectrometry, X-ray diffraction, and X-ray crystallography are used to determine the structure and properties of proteins and nucleic acids.
Unit 14: Characterization of Biomolecules Proteins and nucleic acids are analyzed for structure, function, and composition using various biochemical techniques.
Unit 15: Electrophoresis Techniques Electrophoresis separates molecules based on size and charge. Techniques include agarose gel electrophoresis (AGE), PAGE, and SDS-PAGE for protein analysis.

Suggested Books:

Plummer, D.T. (1996). An Introduction to Practical Biochemistry. Tata McGraw-Hill Publishing Co. Ltd. New Delhi. 3rd edition.

Ruzin, S.E. (1999). Plant Microtechnique and Microscopy, Oxford University Press, New York. U.S.A.

Ausubel, F., Brent, R., Kingston, R. E., Moore, D.D., Seidman, J.G., Smith, J.A., Struhl, K. (1995). Short Protocols in Molecular Biology. John Wiley & Sons. 3rd edition.

Zar, J.H. (2012). Biostatistical Analysis. Pearson Publication. U.S.A. 4th edition.

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Course Name: Microsoft Office Practices	Course Code: UGMOP
Semester: IV	Core / Elective: Core
Teaching Scheme in Hrs (L:T:P):	Credits: 2
Type of course: Lecture+ Assignments	Total Contact Hours:
Continuous Internal Evaluation:	ESE:

Course Outcomes (COs)

After successful completion of this course, students will be able to:

CO1 Understand Computer Fundamentals

Identify the basic components of a personal computer, explain their functions, and recognize various computer peripherals and input/output devices.

CO2 Develop MS-Word Skills

Create, edit, format, save, and protect documents using MS-Word, including page setup, file management, and text editing operations.

CO3 Apply MS-Excel for Data Handling and Analysis

Manage workbooks and worksheets, use formulas and functions, perform calculations, format data, and create charts for data analysis in MS-Excel.

CO4 Use Internet and Communication Tools Effectively

Access and navigate the internet, search and download information, and send/receive emails for academic and professional communication.

Unit 1: Understanding a Personal Computer and how it operates a. Given a PC Diagram into its components, name its various components and list their functions b. Identification of various parts of a computer and peripherals
Unit 2:MS-WORD a. File Management: Opening, creating and saving a document, locating files, copying contents in some different file(s),
Unit 3: protecting files, giving password protection for a file, Page set up: Setting margins, tab setting, ruler, indenting. Editing a document: - Entering text, Cut, copy, paste using tool- bars Work books:
Unit 4: Managing workbooks (create, open, close, save), working in work books, selecting the cells, choosing commands, data entry techniques, formula, creation and links, controlling calculations, working with arrays.
Unit 5: Editing a worksheet, copying, moving cells, pasting, inserting, deletion cells, rows, columns, find and replace text, numbers of cells, formatting worksheet. Creating a chart:-Working with chart types, changing data in chart, formatting a chart, use chart to analyze data
Unit 6: MS-Excel a. How to change view of worksheet, outlining a worksheet, customize workspace, using templates to create default workbooks, protecting work book, Exchange data with other application: linking and embedding, embedding objects, linking to other applications, import, and export document.
Unit 7: Internet and its Applications, Log-in to internet ,Navigation for information seeking on internet, loading of information from internet , Sending and receiving e-mail Browsing and down
Reference Books **1.P.K. Sinha & Priti Sinha** – *Computer Fundamentals* Useful for understanding computer basics, hardware, software, peripherals, and operating systems. 2. **Joan Lambert** – *Microsoft Word Step by Step* Covers document creation, editing, formatting, page setup, and file management in MS-Word

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3. **Michael Miller** – *Absolute Beginner's Guide to Computer Basics*
Covers computer operations, internet usage, email, and practical digital skills for beginners.
4. **Learning Computer Fundamentals, MS Office and Internet & Web Tech**
Includes computer basics, MS Word, Excel, internet, and email applications.

Course Name: Search Engine Marketing	Course Code: UGSEM
Semester: IV	Core / Elective: Core
Teaching Scheme in Hrs (L:T:P):	Credits: 4
Type of course: Lecture+ Assignments	Total Contact Hours:
Continuous Internal Evaluation:	ESE:

COURSE OUTCOME: The student would be able CO1:Understand the fundamentals of Search Engine Marketing (SEM), Google search mechanisms, and rule-based personalization for digital marketing at internet scale. CO2:Analyze and apply concepts of Google Ads and Microsoft Advertising (Bing Ads), including campaign setup, landing page design, and optimization techniques. CO3:Demonstrate knowledge of Pay-Per-Click (PPC) advertising, including terminology such as Quality Score, conversion rate, and campaign performance metrics. CO4:Evaluate and optimize advertising campaigns using Quality Score, goal setting, actionable metrics, and performance measurement strategies. CO5: Design and manage structured PPC campaigns by implementing keyword segmentation, match types, bidding strategies (manual and automated), and non-overlapping ad groups. CO6:Apply advanced SEM strategies including remarketing, mobile advertising, display campaigns, and performance tracking using Google Analytics to improve campaign effectiveness and ROI.
Unit 1: Understanding Importance Google search, Rule based personalization of marketing at internet scale,
Unit 2:, Overview of Google Ads, Bing Ads, landing pages, elements, optimization.
Unit 3:. PPC definition & it's functioning, PPC Terminology - Quality Score, Conversion, Rate etc
Unit 4: Quality Score Overview, setting objectives, goals & expectations, Actionable metrics for performance measurements
Unit 5: Formulating account structure, Effective segmentation of keywords, Usage of multiple match types
Unit6: Non-overlapping Ad Groups Bid Management Plan, understand bidding strategy, Manual vs. Automated bid management
Unit 7: Different bid management, features like CPA bidding, position preference etc.

Unit 8: Effective landing pages and user psychology importance of ui/ux design, -call-to- action
Unit:9 understand & connect with the user and benefit from search behaviour of prospective customer
Unit 10: Performance tracking set campaign objectives &goals, define performance metrics and monitor ppc activity with google analytics.
Unit 11: SEM management (other techniques) re- marketing, mobile advertising, display & video formats,
Unit 12: optimize the display network campaigns and track & measure views through conversions.

Text/Reference Books

Chaffey, D., Ellis-Chadwick, F., Johnston, K., & Mayer, R. (2019). Digital Marketing: Strategy, Implementation and Practice (7th ed.). Pearson Education India. ISBN: 978-9352866527.

Mohan, A. (2017). Search Engine Marketing, Inc.: Driving Search Traffic to Your Company's Web Site (3rd ed.). McGraw-Hill Education. ISBN: 978-9352603765.

Choudhary, R. (2016). Search Engine Marketing. Laxmi Publications. ISBN: 978-8131808781.

Singh, K. (2018). Search Engine Marketing and Optimization: A Practical Guide. PHI Learning Private Limited. ISBN: 978-8120352267.

Gupta, N., & Singh, G. (2015). Search Engine Marketing: Concepts, Methodologies, Tools, and Applications. IGI Global. ISBN: 978-1466684869.

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Course Name: BIG DATA ANALYTICS	Course Code: UGBDA
Semester: IV	Core / Elective: Core
Teaching Scheme in Hrs (L:T:P):	Credits: 2
Type of course: Lecture+ Assignments	Total Contact Hours:
Continuous Internal Evaluation:	ESE:

COURSE OVERVIEW AND OBJECTIVES: •To understand the Big Data Platform and its Use cases. •Apply analytics on Structured and Unstructured Data. •Acquire the knowledge and working on Big Data platforms COURSE OUTCOME: The student would be able: CO1:Describe and analyze various Big Data platforms. CO2:Develop Big Data Solutions using Hadoop Eco System. CO 3: Apply Machine Learning Techniques using R.
Unit 1: Introduction to Big Data: Types of Digital Data, Introduction to Big Data, Big Data Analytics, Relational Databases & SQL, Data Cleansing and Preparation, History of Hadoop, Apache Hadoop, Analyzing Data with Unix tools, Analyzing Data with Hadoop, Hadoop Streaming, IBM Big Data Strategy, Infosphere Big Insights and Big Sheets.
Unit 2: HDFS (Hadoop Distributed File System): The Design of HDFS, HDFS Concepts, Command Line Interface, Hadoop file system interfaces, Data flow, Data Ingest with Flume and Scoop and Hadoop archives,
Unit 3: Hadoop I/O: Compression, Serialization, Avro and File-Based Data structures. Map Reduce, Anatomy of a Map Reduce Job Run, Failures, Job Scheduling, Shuffle and Sort, Task Execution, Map Reduce Types and Formats, Map Reduce Features.
Unit 4: Hadoop Eco System Pig: Introduction to PIG, Execution Modes of Pig, Comparison of Pig with Databases, Grunt, Pig Latin, User Defined Functions, Data Processing operators. Hive: Hive Shell, Hive Services, Hive Meta store, Comparison with Traditional Databases, HiveQL, Tables, Querying Data and User Defined Functions
Unit 5:. Hbase,HBasics, Concepts, Clients, Example, Hbase Versus RDBMS. Big SQL, Data Analytics with R, Machine Learning: Introduction, Supervised Learning, Unsupervised Learning, collaborative filtering. Big Data Analytics with BigR.

Text/Reference Books

1.Data Science for Business by F. Provost and T. Fawcett, O'Reilly Media.
2.Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics by Bill Franks, John Wiley & Sons.
3.Hadoop: The Definitive Guide by Tom White, O'reily Media.
4.Big Data and Business Analytics by Jay Liebowitz, Auerbach Publications, CRC Press

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Course Name: Linear Algebra	Course Code: UGMAT301
Semester: 5	Core / Elective: Core
Teaching Scheme in Hrs (L:T:P):	Credits: 4
Type of course: Lecture+ Assignments	Total Contact Hours: 12
Continuous Internal Evaluation:	ESE:

Course Outcomes: The course will enable the students to learn about:
CO1.Understand the structure of vector spaces, subspaces, linear span, and direct sums to explore foundational concepts in abstract algebra.
CO2.Determine linear dependence and independence, compute basis and dimension, and analyze vector space structure in practical contexts.
CO3.Apply the concepts of linear transformations to compute null space, range, rank, and matrix representation, including the use of characteristic roots.
CO4.Examine special types of linear transformations such as nilpotent transformations and evaluate trace-related properties in transformation algebra.
CO5.Construct orthonormal bases using the Gram-Schmidt process and analyze inner product spaces, including orthogonality and projection concepts.

Unit 1: Definition and Properties of Vector Spaces
This unit introduces vector spaces, including their definition, basic properties, and examples. It explains the axioms that define a vector space and illustrates them through standard examples, providing a foundation for further study in linear algebra.

Unit 2: Subspaces and Related Theorems
This unit focuses on subspaces of vector spaces and the conditions required for a subset to be a subspace. It includes important theorems related to subspaces and explains how subspaces inherit the structure of the parent vector space.

Unit 3: Sum and Direct Sum of Subspaces
This unit explains the concepts of linear sum and direct sum of subspaces. It highlights the conditions under which a sum of subspaces becomes a direct sum and discusses their significance in decomposing vector spaces.

Unit 4: Linear Dependence and Independence
This unit introduces the concepts of linear dependence and linear independence of vectors. It explains criteria for determining whether a set of vectors is dependent or independent and their importance in vector space analysis.

Unit 5: Linear Combination and Span
This unit discusses linear combinations of vectors and the concept of the linear span of a subset of a vector space. It explains how spans generate subspaces and their role in describing vector spaces.

Unit 6: Basis and Dimension
This unit focuses on the concepts of basis and dimension of a vector space. It also explains the dimension of subspaces and quotient spaces, highlighting how dimension measures the size and structure of a vector space.

Unit 7: Definition and Fundamental Concepts
This unit introduces linear transformations and explains key concepts such as null space, range, rank, and nullity. It emphasizes the relationship between these concepts and the structure of vector spaces.

Unit 8: Algebra of Linear Transformations
This unit discusses operations on linear transformations and their algebraic properties. It explains how transformations can be combined and manipulated within a vector space framework.

Unit 9: Matrix Representation and Characteristic Roots This unit explains how linear transformations can be represented using matrices. It introduces characteristic roots and discusses their importance in understanding the behavior of transformations.
Unit 10: Nilpotent Transformations This unit introduces nilpotent transformations and explains their definition and properties. It highlights how repeated application of such transformations leads to the zero transformation.
Unit 11: Trace of a Linear Transformation This unit discusses the concept of trace of a linear transformation and its properties. It explains how trace is related to matrix representation and its significance in linear algebra.
Unit 12: Properties and Applications of Special Transformations This unit focuses on the broader implications of special linear transformations, including their algebraic behavior and applications in simplifying problems in vector spaces.
Unit 13: Inner Product Spaces and Properties This unit introduces inner product spaces, including their definition, examples, and basic properties. It explains how inner products generalize the concept of dot product and enable measurement of angles and lengths.
Unit 14: Orthogonality and Orthonormal Basis This unit discusses orthogonal complements of subspaces and the concept of orthonormal sets and bases. It highlights their importance in simplifying vector space computations.
Unit 15: Gram-Schmidt Orthogonalization Process This unit explains the Gram-Schmidt orthogonalization process, which converts a set of linearly independent vectors into an orthonormal basis. It emphasizes its practical application in constructing orthogonal systems.

Suggested Books:

1. Friedberg S.H., Insel A.J., Spence L.E., (2004), Linear Algebra, 4th Edition, Prentice-Hall of India Pvt. Ltd., New Delhi.
2. Lay D.C., (2007), Linear Algebra and its Applications, 3rd Edition, Pearson Education Asia, Indian Reprint.
3. Lang S., (2005), Introduction to Linear Algebra, 2nd Edition, Springer.
4. Strang L., (2007), Linear Algebra and its Applications, Thomson.

Course Name: Numerical Analysis	Course Code: UGMAT303
Semester: 5	Core / Elective: Core
Teaching Scheme in Hrs (L:T:P):	Credits: 4
Type of course: Lecture+ Assignments	Total Contact Hours: 12
Continuous Internal Evaluation:	ESE:

Course Outcomes:
The course will enable the students to learn the following:
CO1: Apply numerical methods such as bisection, secant, Newton-Raphson, and Regula-Falsi to approximate the roots of algebraic and transcendental equations, and evaluate their convergence properties.
CO2: Solve systems of linear equations using Gaussian elimination, LU factorization, Jacobi and Gauss-Seidel iterative methods, and analyze their convergence behavior.
CO3: Construct interpolation polynomials using Newton's and Lagrange's methods for unequally spaced data and use central difference formulas for equally spaced data.
CO4: Implement numerical techniques for differentiation and integration such as Trapezoidal, Simpson's 1/3, 3/8, and Weddle's rules to approximate values of definite integrals.
CO5: Apply numerical methods like Picard's, Euler's, Modified Euler's, and Runge-Kutta methods to solve ordinary differential equations and interpret their accuracy and stability.

Unit 1: Methods for Solving Algebraic and Transcendental Equations
This unit introduces numerical methods for solving algebraic and transcendental equations. It includes techniques such as the bisection method, Newton-Raphson method, secant method, Regula Falsi method, and iteration method. The focus is on approximating roots when analytical solutions are not feasible.

Unit 2: Iterative Methods and Convergence
This unit explains iterative approaches for solving equations and emphasizes the concept of convergence. It discusses how successive approximations approach the true solution and the conditions required for convergence.

Unit 3: Rate of Convergence of Methods
This unit focuses on the rate of convergence of various numerical methods. It compares different methods based on their efficiency and speed in reaching accurate solutions.

Unit 4: Direct Methods for Solving Linear Systems
This unit discusses direct methods such as factorization and Gaussian elimination for solving systems of linear algebraic equations. It explains step-by-step procedures for obtaining exact solutions.

Unit 5: Iterative Methods for Linear Systems
This unit introduces iterative methods including the Jacobi method and Gauss-Seidel method. It explains how these methods generate approximate solutions through repeated iterations.

Unit 6: Convergence Analysis of Iterative Methods
This unit focuses on the convergence analysis of iterative methods. It explains the conditions under which these methods converge and compares their performance.

Unit 7: Difference Operators and Their Applications
This unit introduces difference operators such as shift, forward, backward, and central differences. It explains their role in numerical analysis and their use in approximating functions.

Unit 8: Interpolation for Unequal Intervals
This unit discusses interpolation techniques for unequal intervals, including Lagrange interpolation and Newton's divided difference method. It focuses on constructing functions that pass through given data points.

Unit 9: Interpolation for Equal Intervals
This unit explains interpolation formulas for equal intervals, including Newton-Gregory forward and

backward interpolation. It also introduces Stirling's, Bessel's, Gauss forward, and Gauss backward interpolation formulas (without proof).
Unit 10: Numerical Differentiation This unit introduces numerical differentiation and explains methods for approximating derivatives using discrete data. It highlights practical applications where exact differentiation is not possible.
Unit 11: Numerical Integration Techniques This unit discusses numerical integration methods such as the trapezoidal rule and Simpson's rules. It explains how definite integrals can be approximated using finite sums.
Unit 12: Advanced Integration Rules This unit covers Simpson's 1/3 rule, Simpson's 3/8 rule, and Weddle's rule. It emphasizes their accuracy and applicability in evaluating integrals numerically.
Unit 13: Introduction to Numerical Methods for Differential Equations This unit introduces numerical integration methods for solving first order ordinary differential equations. It focuses on situations where analytical solutions are difficult to obtain.
Unit 14: Basic Methods for Solving Differential Equations This unit discusses Picard's method, Euler's method, and the modified Euler's method. It explains how these methods approximate solutions using step-by-step procedures.
Unit 15: Runge-Kutta Methods This unit introduces Runge-Kutta methods of second and fourth order. It highlights their importance as accurate and widely used techniques for solving differential equations numerically.
List of Practical (i) Bisection Method. (ii) Newton Raphson Method. (iii) Secant Method. (iv) Regula falsi Method. (v) Gauss-Jacobi Method. (vi) SOR Method or Gauss-Siedel Method. (vii) Lagrange Interpolation or (viii) Newton Interpolation. (ix) Simpson's 1/3 rule. (x)Simpson's 3/8 rule.

Suggested Books:

1. Bradie B., (2007), A Friendly Introduction to Numerical Analysis, Pearson Education, India.
2. Jain M.K., Iyengar S.R.K. and Jain R.K., (2007), Numerical Methods for Scientific and Engineering Computation, 6th Edition, New age International Publisher, India.
3. Gerald C.F. and Wheatley P.O., (2008), Applied Numerical Analysis, Pearson Education, India.
4. Ascher U.M. and Greif C., (2013), A First Course in Numerical Methods, 7th Edition, PHI Learning Private Limited.
5. Mathews J.H. and Fink K.D., (2012), Numerical Methods using MATLAB, 4th Edition, PHI Learning Private Limited.

Course Name: Modern Physics	Course Code: UGPHY301
Semester: 5	Core / Elective: Core
Teaching Scheme in Hrs (L:T:P):	Credits: 4
Type of course: Lecture+ Assignments	Total Contact Hours: 12
Continuous Internal Evaluation:	ESE:

Course Outcomes:
CO1: Understand and explain atomic models, photon concepts, matter waves, and calculate energy levels and spectra for hydrogen-like atoms.
CO2: Apply and analyze Heisenberg uncertainty principles to describe measurement limitations and estimate energies of confined quantum systems.
CO3: Solve and interpret basic quantum mechanical problems using the Schrödinger equation and wave functions, including applications to simple systems like quantum dots.
CO4: Understand and evaluate nuclear structure models, binding energy concepts, and the nuclear force to explain nuclear stability.
CO5: Explain and analyze laser action mechanisms, population inversion, and describe the working principles and applications of common laser systems.

Unit 1: Radiation and Particle Nature of Light
This unit introduces Planck's constant and the concept of light as a collection of photons. It explains Compton scattering as evidence of the particle nature of radiation, establishing the foundation for quantum theory.

Unit 2: Matter Waves and Experimental Evidence
This unit focuses on the wave nature of matter through de Broglie wavelength and matter waves. It includes the Davisson–Germer experiment as experimental confirmation of wave-particle duality.

Unit 3: Atomic Models and Hydrogen Spectrum
This unit discusses the Rutherford atomic model and Bohr's model, including quantization rules and atomic stability. It also covers the calculation of energy levels for hydrogen-like atoms and explanation of their spectral lines.

Unit 4: Measurement and Wave-Particle Duality
This unit explains the concept of position measurement and the fundamental idea of wave-particle duality. It highlights the limitations of classical concepts in describing microscopic systems.

Unit 5: Heisenberg Uncertainty Principle
This unit introduces the Heisenberg uncertainty principle and explains the impossibility of a particle following a definite trajectory. It also includes applications such as estimating the minimum energy of a confined particle.

Unit 6: Energy-Time Uncertainty and Implications
This unit covers the energy-time uncertainty principle and discusses its implications in quantum systems, including transient states and measurement limitations.

Unit 7: Wave Nature and Interference
This unit explains the two-slit interference experiment with photons and electrons, demonstrating the principle of superposition. It introduces wave functions, their linearity, and the concept of quantum states.

Unit 8: Schrödinger Equation and Operators
This unit presents the time-independent Schrödinger wave equation for non-relativistic particles. It introduces momentum and energy operators and their role in quantum mechanics.

Unit 9: Interpretation and Applications of Wave Function
This unit focuses on the physical interpretation of the wave function, including probability density,

normalization, and probability current density in one dimension. It also includes the solution of a particle in a one-dimensional infinite potential well and its application in quantum dots.
Unit 10: Nuclear Structure and Properties This unit introduces the size and structure of the atomic nucleus and its relation to atomic weight. It explains why electrons cannot exist within the nucleus using the uncertainty principle and discusses the nature of nuclear forces.
Unit 11: Nuclear Models and Binding Energy This unit explains the NZ graph and introduces the liquid drop model, including the semi-empirical mass formula and the concept of binding energy in nuclei.
Unit 12: Shell Model and Nuclear Stability This unit covers the nuclear shell model and explains the concept of magic numbers, highlighting their significance in nuclear stability.
Unit 13: Fundamentals of Laser Action This unit explains the theory of laser action, including spontaneous and stimulated emission, density of states, and Einstein's coefficients. It also discusses the ratio of stimulated to spontaneous transitions in thermal equilibrium.
Unit 14: Population Inversion and Amplification This unit focuses on the energy density of radiation due to stimulated emission and absorption, and the conditions required for amplification. It explains the concept of population inversion and methods of optical pumping.
Unit 15: Laser Types and Applications This unit discusses the working principles of laser sources such as He–Ne and semiconductor lasers. It also highlights their important applications in science, industry, and technology.
Practical's: To determine value of Boltzmann constant using V-I characteristic of PN diode. To determine work function of material of filament of directly heated vacuum diode. To determine the ionization potential of mercury. To determine value of Planck's constant using LEDs of at least 4 different colours. To determine the wavelength of H-alpha emission line of Hydrogen atom. To determine the absorption lines in the rotational spectrum of Iodine vapour. To study the diffraction patterns of single and double slits using laser and measure its intensity variation using Photosensor & compare with incoherent source – Na. Photo-electric effect: photo current versus intensity and wavelength of light; maximum energy of photo-electrons versus frequency of light. To determine the value of e/m by (a) Magnetic focusing or (b) Bar magnet. To setup the Millikan oil drop apparatus and determine the charge of an electron.

Suggested Books:

Concepts of Modern Physics, Arthur Beiser, 2009, McGraw-Hill
Modern Physics, J.R. Taylor, C.D. Zafiratos, M.A. Dubson,2009, PHI Learning
Six Ideas that Shaped Physics: Particle Behave like Waves, Thomas A. Moore, 2003, McGraw Hill
Quantum Physics, Berkeley Physics, Vol.4. E.H. Wichman, 2008, Tata McGraw- Hill Co.
Modern Physics, R.A. Serway, C.J. Moses, and C.A.Moyer, 2005, Cengage Learning.
A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi.

Course Name: Nuclear and Particle Physics	Course Code: UGPHY302
Semester: 5	Core / Elective: Core
Teaching Scheme in Hrs (L:T:P):	Credits: 4
Type of course: Lecture+ Assignments	Total Contact Hours:
Continuous Internal Evaluation:	ESE:

Course Outcomes:
CO1: Understand and explain basic nuclear properties, nuclear forces, and models such as the liquid drop model and semi-empirical mass formula.
CO2: Analyze and evaluate nuclear models, nuclear fission processes, reactor types, and neutron cycles in nuclear reactors.
CO3: Explain and apply concepts of weak and strong interactions, including β-decay, parity violation, and resonance phenomena in nuclear and particle systems.
CO4: Understand and interpret elementary particles, quantum numbers, quark models, and fundamental conservation laws in particle physics.
CO5: Apply and analyze nuclear techniques, particle accelerators, and detection methods used in nuclear and high-energy physics experiments.

Unit 1: Nuclear Properties and Structure
This unit introduces the fundamental properties of atomic nuclei including size, shape, and charge distribution. It explains intrinsic properties such as nuclear spin and parity, providing insight into the internal structure and behavior of nuclei.

Unit 2: Binding Energy and Nuclear Models
This unit focuses on nuclear binding energy and its significance in determining nuclear stability. It includes the semi-empirical mass formula and explains the liquid drop model as a macroscopic approach to understanding nuclear structure and energy.

Unit 3: Nuclear Forces and Interactions
This unit discusses the nature of nuclear forces, particularly nucleon-nucleon interactions. It explains the characteristics and form of the nuclear potential, highlighting the short-range and strong nature of these forces.

Unit 4: Nuclear Models and Magic Numbers
This unit explains empirical evidence for regularities in nuclear properties such as nuclear mass, binding energy, and magic numbers. It discusses the liquid drop model and introduces the single particle shell model along with the concept of average potential.

Unit 5: Electromagnetic Properties and Transitions
This unit focuses on multipole fields, electromagnetic matrix elements, and the relationship between lifetime and energy of nuclear states. It explains how these properties are used to study nuclear structure and transitions.

Unit 6: Nuclear Fission and Reactor Physics
This unit covers the discovery and theory of nuclear fission, including energy release during fission. It explains the concept of reactor criticality, the four-factor formula, types of reactors including breeder reactors, and the neutron cycle in thermal nuclear reactors.

Unit 7: Weak Interaction and Beta Decay
This unit deals with weak interactions, focusing on nuclear beta decay and the role of neutrinos. It explains electron capture, Fermi and Gamow–Teller transitions, and the Fermi theory of beta decay along with relevant selection rules in the non-relativistic case.

Unit 8: Neutrino Properties and Parity Violation
This unit discusses the properties of neutrinos including their mass and the phenomenon of parity

violation. It highlights experimental observations that led to the understanding of symmetry breaking in weak interactions.
Unit 9: Strong Interaction and Alpha Decay This unit explains the strength and characteristics of strong nuclear interactions, including nuclear and particle resonances. It covers alpha decay through barrier penetration theory and discusses experimental observations and selection rules governing strong interactions.
Unit 10: Fundamental Forces and Particle Classification This unit introduces the classification of fundamental forces and elementary particles. It explains various quantum numbers such as charge, spin, parity, isospin, and strangeness used to describe particles.
Unit 11: Particle Models and Relations This unit focuses on the Gell-Mann–Nishijima formula and the quark model. It explains the classification of hadrons into baryons and mesons and describes their internal structure based on quark composition.
Unit 12: Symmetry and Conservation Laws This unit discusses conservation laws and symmetry principles in particle physics, including charge conjugation (C), parity (P), and time reversal (T) invariance. It explains their importance in understanding particle interactions.
Unit 13: Particle Accelerators This unit introduces different types of particle accelerators such as tandem and electrostatic generators, linear accelerators including drift tube accelerators, and orbital accelerators like cyclotrons and synchrocyclotrons. It explains their working principles and applications.
Unit 14: Magnetic Systems and Neutron Production This unit focuses on bending and focusing magnets and the working of magnetic spectrometers. It also explains methods for the production of high-energy neutrons and their significance in nuclear experiments.
Unit 15: Radiation Detectors This unit deals with various radiation detection techniques including ionization chambers, Geiger–Müller counters, and scintillation detectors. It explains their principles, working, and applications in nuclear measurements and research.
Practical's: To study the characteristics of a Geiger-Muller counter and to determine the plateau and the operating voltage of the given GM counter. To Study the Inverse Square Law of Radiation distribution. To Study of Beta absorption in metal foils and end point energy. To Study of Gamma Attenuation Coefficient (Pb or Fe). To study of statistical distribution in nuclear events.

Suggested Books:

Introductory nuclear Physics, Kenneth S. Krane. (Wiley India Pvt. Ltd., 2008).
Concepts of nuclear Physics, Bernard L. Cohen. (Tata McGraw Hill, 1998).
Introduction to the Physics of nuclei & particles, R.A. Dunlap. (Thomson Asia, 2004)

Course Name: Physical Chemistry	Course Code: UGCHM301
Semester: 5	Core / Elective: Core
Teaching Scheme in Hrs (L:T:P):	Credits: 4
Type of course: Lecture+ Assignments	Total Contact Hours: 12
Continuous Internal Evaluation:	ESE:

Course Outcomes:
CO1: Students will be able to get the knowledge of Kinetic gas equation & Maxwell distribution law & viscosity of gases.
CO2: Students will be able to analyze the deviations from ideal gas behavior & itscauses and Vander Waals equation & its applications.
CO3: Students will be able to compare the various properties of liquids & solids and also analyze the Miller indices. X– Ray diffraction by crystals, Bragg's law.
CO4: Students will be able to apply the knowledge of electrolytes on pH scale, common ion effect, Buffer solutions and applications of solubility product principle.
CO5: Students will be able to understand the conductance & its applications, transport number & its determination and conductometric titrations & to evaluate the physical parameters like pH, viscosity, surface tension etc. experimentally.

Unit 1: Kinetic Theory of Gases
This unit deals with the fundamental postulates of the kinetic theory of gases and the derivation of the kinetic gas equation. It explains the assumptions regarding molecular motion, collisions, and energy distribution, providing a theoretical basis for understanding gaseous behavior.

Unit 2: Molecular Collisions and Transport Properties
This unit focuses on collision frequency, collision diameter, mean free path, and viscosity of gases. It explains how molecular size and interactions influence the physical properties of gases and their flow behavior.

Unit 3: Maxwell Distribution and Molecular Velocities
This unit explains Maxwell's distribution law and its application in determining different types of molecular velocities, including average, root mean square, and most probable velocities. It also covers the concept of average kinetic energy and its relation to temperature.

Unit 4: Deviations from Ideal Behavior
This unit explains the deviations of real gases from ideal gas behavior. It introduces the compressibility factor (Z) and discusses its variation with pressure and temperature for different gases, along with the causes of non-ideal behavior.

Unit 5: Vander Waals Equation and Applications
This unit covers the derivation of the Vander Waals equation of state and its application in explaining the behavior of real gases. It highlights how intermolecular forces and molecular volume are accounted for in real gas systems.

Unit 6: Isotherms and Critical State
This unit discusses the isotherms of real gases and compares them with Vander Waals isotherms. It also explains the concept of the critical state and its significance in understanding phase transitions.

Unit 7: Surface Tension and Viscosity of Liquids
This unit explains the concept of surface tension and its determination using a stalagmometer, along with the concept of viscosity and its measurement using an Ostwald viscometer. It also discusses the qualitative effect of temperature on surface tension and viscosity.

Unit 8: Structure and Forms of Solids
This unit introduces different forms of solids and explains symmetry elements and unit cells. It provides a basic understanding of the internal arrangement of particles in crystalline solids.

Unit 9: Crystallography and X-Ray Diffraction This unit covers the laws of crystallography, including the law of constancy of interfacial angles and the law of rational indices. It explains Miller indices and the principles of X-ray diffraction, including Bragg's law, for determining crystal structure.
Unit 10: Electrolytes and Ionization This unit deals with strong, moderate, and weak electrolytes and explains the concept of degree of ionization. It also covers the ionic product of water and introduces the pH scale for measuring acidity and basicity.
Unit 11: Common Ion Effect and Hydrolysis This unit explains the common ion effect and its influence on ionic equilibria. It also covers salt hydrolysis, including the calculation of hydrolysis constant and degree of hydrolysis, along with the concept of buffer solutions.
Unit 12: Solubility Product and Applications This unit focuses on the solubility and solubility product of sparingly soluble salts. It explains the applications of the solubility product principle in predicting precipitation and solubility behavior.
Unit 13: Basic Concepts of Electrochemistry This unit introduces the Arrhenius theory of electrolytic dissociation and explains the concept of electrical conductivity. It defines equivalent and molar conductivity and discusses the effect of dilution on conductivity.
Unit 14: Ionic Migration and Transport Numbers This unit explains Kohlrausch's law of independent migration of ions and introduces the concept of transport number. It also covers the experimental determination of transport numbers using Hittorf and moving boundary methods, along with ionic mobility.
Unit 15: Conductometric Applications This unit focuses on conductometric titrations and their applications in analytical chemistry. It explains how changes in conductivity are used to determine the endpoint of titrations.

Suggested Books:

1.Atkins, P. W. & Paula, J. de Atkin's Physical Chemistry Ed., Oxford University Pres, 12th edition 2022.
2.Ball, D. W. Physical Chemistry Thomson Press, India 2007.
3.Castellan, G. W. Physical Chemistry 4th Ed. Narosa 2004.
4.Mortimer, R. G. Physical Chemistry 3rd Ed. Elsevier: NOIDA, UP 2014.

Digital References:

1.https://chemistlibrary.files.wordpress.com/2015/02/instant-notes-in-physical-chemistry.pdf
2.**https://youtu.be/PQechXuFoyI**

Course Name: Organic Chemistry	Course Code: UGCHM302
Semester: 5	Core / Elective: Core
Teaching Scheme in Hrs (L:T:P):	Credits: 4
Type of course: Lecture+ Assignments	Total Contact Hours: 12
Continuous Internal Evaluation:	ESE:

Course Outcomes:
CO1: Students will be able to analyze the disconnection approach.
CO2: Students will be able to understand & apply to oxidation process.
CO3: Students will be able to understand & apply reduction process.
CO4: Students will be able to compare the protecting groups.
CO5: Students will be able to study organometallic reagents & can apply to synthesize organic derivatives and their purification.

Unit 1: Aromaticity and Structural Features
This unit explains the concept of aromaticity based on Hückel's rule, emphasizing the criteria required for a compound to exhibit aromatic character. It includes the study of arenes and their stability, along with cyclic carbocations and carbanions. The aromatic nature of heterocyclic compounds is also discussed with suitable examples to illustrate electron delocalization and resonance stability.

Unit 2: Electrophilic Aromatic Substitution Reactions
This unit focuses on electrophilic aromatic substitution reactions, including halogenation, nitration, sulphonation, and Friedel-Crafts alkylation and acylation. It explains the detailed mechanisms of these reactions and the role of electrophiles. The concept of directing effects of substituent groups on the benzene ring is also covered, highlighting ortho, meta, and para orientations.

Unit 3: Diazonium Salts and Applications
This unit deals with the preparation of diazonium salts and their stability. It explains their important synthetic applications in organic chemistry, including substitution and coupling reactions, which are widely used in the synthesis of dyes and other aromatic compounds.

Unit 4: Carbon–Carbon Bond Formation Reactions
This unit covers important name reactions involving carbon–carbon bond formation such as Aldol, Perkin, Benzoin, Cannizzaro, Wittig, Grignard, and Reformatsky reactions. It explains their mechanisms, conditions, and synthetic significance in building complex organic molecules.

Unit 5: Rearrangements, Reductions and Oxidations
This unit focuses on rearrangement reactions including Meerwein, Hoffmann, Claisen, and Favorsky rearrangements. It also includes oxidation and reduction reactions such as hydroboration, Oppenauer oxidation, Clemmensen reduction, Meerwein–Ponndorf–Verley reduction, and Birch reduction. The mechanisms and applications of these transformations are discussed in detail.

Unit 6: Addition and Cycloaddition Reactions
This unit explains various addition and cycloaddition reactions such as Stork enamine reaction, Michael addition, Mannich reaction, Diels–Alder reaction, Ene reaction, and Baeyer–Villiger reaction. It highlights their mechanisms and importance in synthetic organic chemistry.

Unit 7: Six-Membered Heterocycles
This unit deals with the synthesis and reactivity of six-membered heterocyclic compounds such as pyridine, quinoline, isoquinoline, pyridazine, pyrimidine, and pyrazine. It explains their structural features, aromaticity, and chemical behavior.

Unit 8: Five-Membered Heterocycles with One Heteroatom
This unit focuses on five-membered heterocyclic compounds containing a single heteroatom,

including indole, benzofuran, and benzothiophene. It covers their synthesis, structure, and reactivity patterns.
Unit 9: Five-Membered Heterocycles with Two Heteroatoms This unit explains heterocyclic systems containing two heteroatoms such as pyrazole, imidazole, oxazole, isoxazole, thiazole, and isothiazole. It discusses their preparation methods and chemical properties.
Unit 10: Preparation of Organoboranes This unit describes the preparation of organoboranes through hydroboration reactions using reagents such as BH_3–THF, dicyclohexylborane, disiamylborane, thexylborane, 9-BBN, and disopinocampheylborane. It explains the principles and selectivity of hydroboration reactions.
Unit 11: Functional Group Transformations This unit focuses on the transformations of organoboranes into various functional groups. It includes oxidation, protonolysis, and rearrangement reactions, explaining their mechanisms and synthetic importance.
Unit 12: Synthetic Applications of Organoboranes This unit highlights the applications of organoboranes in organic synthesis. It explains how these compounds are used for regioselective and stereoselective transformations, making them valuable intermediates in modern chemistry.
Unit 13: General Features and Isolation of Alkaloids This unit introduces alkaloids, discussing their natural occurrence, general structural features, and methods of isolation. It also explains their physiological actions and significance in medicinal chemistry.
Unit 14: Degradation and Structural Elucidation This unit focuses on classical methods used in structure determination of alkaloids, including Hoffmann's exhaustive methylation and Emde's modification. It explains how these reactions help in understanding the structure of complex natural compounds.
Unit 15: Important Alkaloids and Isoprene Rule This unit covers the structure elucidation and synthesis of important alkaloids such as quinine, morphine, cocaine, and nicotine. It also introduces the isoprene rule and its significance in understanding the structure of natural products.

Suggested Books:

1.Designing Organic Synthesis, S. Warren, Wiley.
2.Advanced Organic Chemistry: Reactions, Mechanisms and Structure, J. March, Wiley.
3.Some Morden Methods of Organic Synthesis, W. Carruthers, Cambridge University Press.
4.Principles of Organic Chemistry, F. A. Carey and R. J. Sundberg, Plenum Press.
5.Rodd's Chemistry of Carbon Compounds Ed. S. Coffey, Elsevier.

Digital References:

1.https://chemistry.tcd.ie/assets/pdf/sf-chemistry/tg/REVISED%20Lectures%20in%20Introduction%20to%20Organic%20Chemistry%202011%20HANDOUT.pdf
2.**https://youtu.be/Eq1vxDl3QmI**

Course Name: Operating System	Course Code: UGCSA208
Semester: 5	Core / Elective: Core
Teaching Scheme in Hrs (L:T:P):	Credits:4
Type of course: Lecture+ Assignments	Total Contact Hours:
Continuous Internal Evaluation:	ESE:

Course Outcomes: This course will enable the students to learn:
CO1. Learn the general architecture & functioning of computers with operating systems.
CO2. Describe, contrast, and compare differing structures for operating systems.
CO3. Understand and analyze theory and implementation of processes, and resource control.
CO4. Understand physical and virtual memory, scheduling, I/O, and files
CO5. Use system calls for managing processes, memory, and the file system.

Unit 1: Computer System and OS Fundamentals
This unit introduces the basic components of a computer system and explains the concept of an operating system from both user and system perspectives. It discusses the evolution of operating systems and various types such as single processor systems, multiprocessor systems, real-time systems, distributed systems, multimedia systems, and handheld systems.

Unit 2: Operating System Structure and Services
This unit focuses on the structure of operating systems and the services they provide, including process management, memory management, and file handling. It explains how the operating system acts as an interface between hardware and users.

Unit 3: User Interfaces and System Calls
This unit explains different types of user interfaces, including command-line interfaces and graphical user interfaces. It also introduces system calls and their role in enabling communication between user programs and the operating system.

Unit 4: Process Concepts and States
This unit introduces the concept of a process and explains process states and transitions using process state diagrams. It also covers the Process Control Block (PCB) and its role in process management.

Unit 5: Scheduling Concepts and Criteria
This unit explains CPU scheduling concepts, performance criteria, scheduling queues, and types of schedulers. It provides an understanding of how processes are selected for execution.

Unit 6: Scheduling Algorithms
This unit covers various CPU scheduling algorithms, including First Come First Serve (FCFS), Shortest Job First (SJF), Priority scheduling, and Round Robin. It distinguishes between preemptive and non-preemptive scheduling techniques.

Unit 7: Principles of Concurrency
This unit explains the concept of concurrent processes, including cooperating processes and the producer-consumer problem. It discusses race conditions and the critical section problem, along with Peterson's solution for process synchronization.

Unit 8: Synchronization Mechanisms and IPC
This unit introduces semaphores and classical synchronization problems such as the dining philosopher problem. It also explains inter-process communication models and schemes for process coordination.

Unit 9: Deadlocks and Their Management
This unit covers the system model of deadlocks, their characterization, and methods for prevention, avoidance, and detection. It also explains recovery techniques to handle deadlock situations.

Unit 10: Basic Memory Management Techniques
This unit introduces basic memory management concepts including bare machine systems, resident

monitors, and multiprogramming with fixed and variable partitions. It explains the role of base registers in memory allocation.
Unit 11: Advanced Memory Management This unit covers paging and segmentation techniques used for efficient memory utilization. It explains how logical memory is mapped to physical memory.
Unit 12: Virtual Memory and Performance This unit explains the concept of virtual memory and demand paging. It also covers performance considerations, page replacement algorithms, allocation of frames, and the role of cache memory in improving system performance.
Unit 13: File Systems and Access Methods This unit introduces different types of files and their access methods. It also explains various file allocation methods used for storing data efficiently on storage devices.
Unit 14: I/O Management and Device Organization This unit explains input-output devices and the organization of I/O functions. It describes how the operating system manages communication between hardware devices and user processes.
Unit 15: Disk Structure and Scheduling Algorithms This unit focuses on disk structure and disk scheduling techniques. It explains algorithms such as FCFS, SSTF, SCAN, C-SCAN, and LOOK, highlighting their role in optimizing disk performance.

Course Name: Advanced Web Applications	Course Code: UGCSA301
Semester: 5	Core / Elective: Core
Teaching Scheme in Hrs (L:T:P):	Credits: 4
Type of course: Lecture+ Assignments	Total Contact Hours:
Continuous Internal Evaluation:	ESE:

Course Outcomes: This course will enable the students to learn:
CO1. Master HTML, CSS, and JavaScript fundamentals.
CO2. Set up and build full-stack applications with Node.js, React, and Django.
CO3. Develop dynamic user interfaces using React.
CO4. Create RESTful APIs with Node.js, Express, and MongoDB.
CO5. Implement server-side rendering and authentication with Next.js, Django, and JWT.

Unit 1: Recap of Web Development Fundamentals
This unit revises core concepts of HTML, CSS, and JavaScript, including structure, styling, and interactivity in web pages. It also covers Document Object Model manipulation, event handling, and basic styling techniques that form the foundation for dynamic web applications.

Unit 2: Introduction to Node.js, React and Django
This unit introduces modern frameworks used in full-stack development, including Node.js for backend development, React for frontend interfaces, and Django as a server-side framework. It includes setting up development environments and understanding the roles of frontend and backend technologies.

Unit 3: MVC Architecture and Full-Stack Setup
The Model-View-Controller architecture is explained as a design pattern for structuring applications. Learners gain practical exposure by setting up a simple full-stack web application integrating Node.js, React, and Django, understanding how different layers interact.

Unit 4: React Components, Props and State
React applications are built using components that manage their own data and behavior. Props are used to pass data between components, while state is used to manage dynamic data within components, enabling interactive user interfaces.

Unit 5: Lifecycle Methods, Forms and Styling
React component lifecycle methods control component behavior during different stages of rendering. Handling user input through forms and events is essential for interactivity. Styling techniques include traditional CSS and modern CSS-in-JS approaches for modular design.

Unit 6: Development of Dynamic UI Project
This unit focuses on applying React concepts to build a dynamic user interface for a web application. It involves creating reusable components, managing state effectively, and ensuring a responsive and interactive design.

Unit 7: RESTful APIs and Server Setup
RESTful APIs enable communication between client and server using standard HTTP methods. This unit covers CRUD operations and setting up a Node.js server using Express framework for handling requests.

Unit 8: Routing, Middleware and Database Integration
Routes are defined to handle different API endpoints, while middleware is used for request processing and error handling. Integration with MongoDB using Mongoose ORM allows efficient data storage and retrieval.

Unit 9: Backend API Development Project
Learners build a complete RESTful API backend that connects with the frontend application. This

includes implementing endpoints, handling data, and ensuring smooth communication between client and server.
Unit 10: Concepts of Server-Side Rendering Server-side rendering improves performance and SEO by rendering web pages on the server before sending them to the client. This unit explains its advantages and working mechanism in modern web applications.
Unit 11: Next.js Framework and Data Fetching Next.js is introduced as a React framework for implementing server-side rendering. It includes project configuration, routing, and server-side data fetching techniques that enhance application performance.
Unit 12: Django Integration and SSR Project Django is used for handling server-side logic and backend processing. This unit focuses on integrating Django with Next.js to implement server-side rendering in a full-stack application through a practical project.
Unit 13: Authentication Concepts and JWT Authentication verifies user identity, while authorization controls access to resources. JSON Web Tokens provide a secure method for user authentication in web applications.
Unit 14: Middleware and Session Management Authentication middleware is implemented in Node.js/Express and Django to secure routes. This unit also covers managing user sessions and tokens to maintain secure access control across the application.
Unit 15: Security Practices and Implementation Project Best practices for authentication and authorization are discussed, including secure storage of tokens and protection against vulnerabilities. Learners implement authentication and authorization features in the developed web application.

Course Name: Chordates & Comparative Anatomy	Course Code: UGZOO301
Semester: 5	Core / Elective: Core
Teaching Scheme in Hrs (L:T:P):	Credits: 4
Type of course: Lecture+ Assignments	Total Contact Hours: 12
Continuous Internal Evaluation:	ESE:

Course Outcomes:
Upon successful completion, the student will be able to
CO1: Explain the evolutionary origins and taxonomic relationships of chordates, including Hemichordata, Cephalochordata, and Urochordata, to elucidate their phylogenetic significance.
CO2: Analyze the structural and functional diversity of chordates, including their morphology, anatomy, and physiology, to identify key characteristics across vertebrate classes (Pisces, Amphibia, Reptilia, Aves, Mammalia).
CO3: Apply taxonomic principles to classify chordates up to the order level and demonstrate identification skills for chordate diversity, including distinguishing features like dentition, neoteny, and snake biting mechanisms.
CO4: Evaluate the comparative anatomy of vertebrate systems (e.g., integumentary, skeletal) to assess evolutionary adaptations and functional significance.
CO5: Examine the comparative organization of the nervous system (brain and cranial nerves) and the classification and function of major sense organs (visual and auditory receptors) in vertebrates.

Unit 1: Origin and Classification of Chordates
Chordates are a diverse group of animals characterized by the presence of a notochord, dorsal nerve cord, and pharyngeal slits at some stage of development. The origin of chordates is explained through evolutionary theories that trace their ancestry to primitive deuterostomes. Classification of phylum Chordata is carried out up to the order level, grouping organisms based on structural and functional similarities.

Unit 2: General Characteristics and Classification of Hemichordata
Hemichordates exhibit features that link non-chordates and chordates, making them important in evolutionary studies. They possess characteristics such as a proboscis, collar, and trunk body division. Classification of Hemichordata includes major groups based on morphological differences, providing insight into their diversity and evolutionary significance.

Unit 3: Detailed Study of Balanoglossus
Balanoglossus is a representative hemichordate studied in detail for its habit, habitat, morphology, anatomy, physiology, and development. It is a marine organism adapted to burrowing life. Its structural organization and developmental features provide important evidence for understanding the evolutionary relationship between chordates and non-chordates.

Unit 4: Cephalochordata: Structure and Function
Cephalochordates are primitive chordates that retain chordate features throughout life. They exhibit general characteristics such as a well-developed notochord and segmented musculature. Their classification is based on structural traits. The study of their habit, habitat, morphology, anatomy, and physiology provides insight into early chordate organization.

Unit 5: Urochordata: Characteristics and Classification
Urochordates show chordate features mainly during larval stages and undergo significant transformation during development. They are classified based on structural and reproductive characteristics. Their simple adult body structure and complex life cycle make them important for understanding chordate evolution.

Unit 6: Detailed Study of Herdmania
Herdmania is a typical urochordate studied in detail for its habit, habitat, morphology, anatomy,

physiology, and post-embryonic development. It is a sessile marine organism with specialized feeding and respiratory systems. Its life cycle demonstrates metamorphosis and loss of certain chordate features in adulthood.
Unit 7: Classification of Vertebrates Vertebrates are classified into major classes such as Pisces, Amphibia, Reptilia, Aves, and Mammalia. Each class is characterized by distinct anatomical and physiological features. Classification up to the order level with examples helps in understanding the diversity and evolutionary relationships among vertebrates.
Unit 8: Special Features and Adaptations in Vertebrates Vertebrates exhibit various adaptations such as venomous and non-venomous snakes with specialized biting mechanisms. Concepts like neoteny and paedogenesis explain variations in developmental patterns. Dentition in mammals shows adaptations to different feeding habits and ecological niches.
Unit 9: Functional and Evolutionary Significance The structural and functional diversity of vertebrates reflects evolutionary adaptations to different environments. Comparative analysis of these features provides insight into evolutionary trends and survival strategies across different vertebrate groups.
Unit 10: Integumentary and Skeletal Systems The integumentary system includes the skin and its derivatives, which serve protective, regulatory, and sensory functions. The skeletal system consists of axial and appendicular components that provide support and facilitate movement. Structures such as jaw suspensorium and visceral arches are important for feeding and respiration.
Unit 11: Digestive and Respiratory Systems The alimentary canal and associated glands are responsible for digestion and absorption of nutrients. The respiratory system varies among vertebrates, reflecting adaptations to aquatic and terrestrial environments. Accessory respiratory organs enhance respiration under specific conditions.
Unit 12: Functional Adaptations in Organ Systems Comparative study of organ systems reveals functional adaptations that enable vertebrates to survive in diverse habitats. These adaptations highlight the relationship between structure and function in biological systems.
Unit 13: Circulatory and Urinogenital Systems The circulatory system shows evolutionary advancement in the structure of the heart and aortic arches, improving efficiency of blood circulation. The urinogenital system includes the succession of kidney types and evolution of ducts, reflecting adaptations in excretion and reproduction.
Unit 14: Nervous System and Brain Organization The nervous system in vertebrates shows increasing complexity, particularly in the brain. A comparative account of the brain and cranial nerves in mammals highlights functional specialization and coordination of activities.
Unit 15: Sense Organs and Receptors Sense organs are specialized structures that detect environmental stimuli. Receptors are classified based on the type of stimulus they detect. Visual and auditory receptors in humans are highly developed, enabling perception of light and sound. These systems play a crucial role in interaction with the environment.
PRACTICALS: Study of Placoid, Cycloid, and Ctenoid Scales in Fishes Comparative Study of Heart in Shark, Frog, and Pigeon Dissection of Brain in Bony Fish / Frog / Pigeon (Virtual / Model-based as per NEP) Mounting of Amphioxus Gill Slits / Section of Skin (Fish, Amphibian, Reptile, Bird, Mammal) Study of Skull Types: Dogfish, Frog, Pigeon, and Rabbit (Disarticulated and Articulated) Comparative Study of Digestive Systems in Vertebrates (Charts or Virtual Lab) Identification and Study of Museum Specimens: Amphioxus, Balanoglossus, Herdmania, Ascidia, Petromyzon, Myxine Comparative Study of Respiratory Structures: Gills, Lungs, Air Sacs in Vertebrates

Suggested Books:

Harvey et al: The Vertebrate Life (2006)

Colbert et al: Colbert's Evolution of the Vertebrates: A history of the backboned animals through time (Sth ed 2002,WiIey - Liss)
Kenneth V. Kardong (2015) Vertebrates: Comparative Anatomy, Function, Evolution McGraw Hill
McF arland et at: Vertebrate Life(\979, Macmillan Publishing)
Romer and Parsons: The Vertebrate Body (6th ed 1986, CBS Publishing Japan) Young' The Life of vertebrates (3rd ed 2006, ELBS/Oxford)
Weichert C.K and william Presch (1970). Elements of Chordate Anatomy, Tata McGraw Hills

Digital References: https://www.khanacademy.org/science/biology

For Vivekananda Global University, Jaipur

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Centre for Distance and Online Education-VGU

Arvind Kumar Singh

Director

Course Name: Animal Biotechnology	Course Code: UGZOO303
Semester: 5	Core / Elective: Core
Teaching Scheme in Hrs (L:T:P):	Credits: 4
Type of course: Lecture+ Assignments	Total Contact Hours: 12
Continuous Internal Evaluation:	ESE:

Course Outcomes: Upon successful completion, the student will be able to
CO1: Master animal cell culture techniques, including lab setup, sterilization, aseptic handling, and media preparation (natural/synthetic/sera).
CO2: Establish primary cultures, perform advanced techniques (roller/suspension culture, bioreactors), and scale up production using microcarriers.
CO3: Utilize fermentation tech (hollow fiber reactors, chemostats) for cell growth, manage cell lines, and apply stem cell culture and manipulation methods.
CO4: Engineer transgenic/cloned animals via nuclear transfer, retroviral methods, and assess applications in pharma, organ transplants, and GM crops.
CO5: Apply molecular biotech in gene expression, disease diagnosis (cystic fibrosis), recombinant drug production (insulin), and gene therapy.

Unit 1: Equipment, Materials, and Culture Facility Design
Animal cell culture requires specialized equipment and materials to maintain sterile and controlled conditions. The design and layout of a culture room are crucial for preventing contamination and ensuring efficient workflow. Essential components include laminar airflow cabinets, incubators, and sterilization units. Proper planning of the culture facility supports optimal growth and maintenance of cells.

Unit 2: Sterilization and Culture Media
Sterilization and aseptic techniques are fundamental to prevent contamination in cell culture. Various methods such as autoclaving, filtration, and chemical sterilization are employed. Culture media provide essential nutrients for cell growth and include natural media, synthetic media, and sera. Balanced salt solutions and simple growth media help maintain osmotic balance and support cellular metabolism.

Unit 3: Growth Conditions and Media Optimization
The selection and optimization of culture media and environmental conditions are critical for successful cell growth. Factors such as pH, temperature, and nutrient composition influence cell proliferation and viability. Proper maintenance of these conditions ensures consistent and reproducible results in cell culture experiments.

Unit 4: Primary Culture and Tissue Disaggregation
Primary cultures are established by disaggregating tissues into individual cells using mechanical or enzymatic methods. Techniques such as candling of eggs and preparation of chick fibroblast cultures are important experimental procedures. Lymphocyte cultures are widely used for chromosomal studies and genetic analysis.

Unit 5: Culture Techniques and Scale-Up Methods
Different culture techniques include roller and suspension cultures, which support cell growth under varying conditions. Large-scale production of cells is achieved using bioreactors, microcarriers, and perfusion techniques. These methods enable efficient production of cells and their products for research and industrial applications.

Unit 6: Cell Characterization and Preservation
Assessment of cell viability and cytotoxicity is essential to evaluate cell health. Biological characterization, including karyotyping, helps in identifying genetic stability of cultured cells.

Cryopreservation allows long-term storage of cells, while proper revival techniques ensure their recovery. Detection of contaminants is crucial for maintaining culture integrity.
Unit 7: Fermentation Technology and Bioreactors Fermentation technology supports the growth of animal cells and production of biological products. Various systems such as hollow fiber reactors, air-lift fermentors, chemostats, and microcarrier-based cultures are used to optimize cell growth. These technologies enhance productivity and efficiency in large-scale applications.
Unit 8: Cell Lines and Stem Cell Cultures Established cell lines are defined populations of cells maintained under controlled conditions. Their maintenance and management require proper techniques to ensure stability and adaptation. Stem cell cultures, including embryonic stem cells, have the ability to differentiate into various cell types and have significant applications in regenerative medicine and research.
Unit 9: Cell Manipulation and Separation Techniques Cell cloning, synchronization, and manipulation are important techniques for studying cell behavior and function. Methods for separation of different cell types enable isolation of specific populations for analysis. Each method has its advantages and limitations, which must be considered in experimental design.
Unit 10: Production of Transgenic Animals Genetically modified animals are produced using techniques such as nuclear transplantation, retroviral methods, and DNA microinjection. These approaches enable the introduction of foreign genes into animal genomes, resulting in desired genetic traits for research and industrial purposes.
Unit 11: Applications of Transgenic Animals Transgenic animals are used for the production of pharmaceuticals, development of donor organs, and creation of knockout mice for studying gene function. These applications contribute significantly to biomedical research and therapeutic advancements.
Unit 12: Transgenic Plants and Their Applications Transgenic plants are developed using methods such as Agrobacterium-mediated transformation. These plants exhibit traits such as insect resistance and herbicide tolerance, improving agricultural productivity and sustainability.
Unit 13: Expression of Cloned Genes in Mammalian Cells Animal cell culture systems are used to express cloned genes in mammalian cells, enabling the production of functional proteins. This approach is essential for studying gene function and producing therapeutic proteins.
Unit 14: Molecular Diagnosis and Recombinant Products Molecular techniques are used for diagnosing genetic diseases such as cystic fibrosis and sickle cell anemia. Recombinant DNA technology enables the production of important medical products such as insulin and human growth hormone, which are widely used in treatment.
Unit 15: Gene Therapy and Biomedical Applications Gene therapy involves the introduction of functional genes to treat genetic disorders. It represents a promising approach in modern medicine. Applications of animal cell culture and recombinant DNA technology continue to advance healthcare and improve disease management.
PRACTICALS: Genomic DNA isolation from *E. coli* Plasmid DNA isolation (pUC 18/19) from *E. coli* Restriction digestion of plasmid DNA. Construction of circular and linear restriction map from the data provided. Calculation of transformation efficiency from the data provided To study following techniques through photographs: Southern Blotting Northern Blotting Western Blotting DNA Sequencing (Sanger's Method) PCR DNA fingerprinting

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Suggested Books:

Brown, T.A. (1998). *Molecular Biology Labfax II: Gene Cloning and DNA Analysis*. II Edition, Academic Press, California, USA.

Glick, B.R. and Pasternak, J.J. (2009). *Molecular Biotechnology - Principles and Applications of Recombinant DNA*. IV Edition, ASM press, Washington, USA.

Griffiths, A.J.F., J.H. Miller, Suzuki, D.T., Lewontin, R.C. and Gelbart, W.M. (2009).*An Introduction to Genetic Analysis*. IX Edition. Freeman and Co., N.Y., USA.

Watson, J.D., Myers, R.M., Caudy, A. and Witkowski, J.K. (2007). *Recombinant DNA- Genes and Genomes- A Short Course*. III Edition, Freeman and Co., N.Y., USA

Digital References:

https://nptel.ac.in/courses/102/103/102103013/

https://ocw.mit.edu/courses/life-sciences/#biology

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Arvind Kumar Singh

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Course Name: DEVELOPMENTAL BIOLOGY OF PLANTS	Course Code: UGBOT301
Semester: 5	Core / Elective: Core
Teaching Scheme in Hrs (L:T:P):	Credits: 4
Type of course: Lecture+ Assignments	Total Contact Hours: 12
Continuous Internal Evaluation:	ESE:

Module 1: Plan Course Outcomes: CO1: Describe the modular growth and variation in plant habits among annuals, biennials, and perennials. CO2: Apply knowledge of root and stem modifications to demonstrate their structural and functional adaptations. CO3: Analyze the morphology and classification of leaves, flowers, inflorescences, and fruits in angiosperms. CO4: Evaluate different tissue types, their structures, functions, and the role of meristems in plant development. CO5: Design a comparative study of leaf anatomy and secondary growth patterns in monocot and dicot plants.t Habit and Growth
Unit 1: Plant Habit and Basic Plan of Flowering Plants Plant habit refers to the general appearance and growth form of plants. Flowering plants follow a basic structural plan consisting of roots, stems, and leaves organized systematically.
Unit 2: Modular Growth in Plants Plants exhibit modular growth where repeated units such as leaves, nodes, and internodes are produced. This allows flexibility and adaptation in growth.
Unit 3: Diversity of Plant Forms Plants show diversity as annuals, biennials, and perennials based on their life cycle and duration of growth.
Unit 4: Root Structure and Modifications Roots anchor the plant and absorb water and nutrients. They show structural modifications for storage such as tap roots and adventitious roots.
Unit 5: Stem Structure and Types The stem supports aerial parts and conducts materials. It shows different types and internal structures.
Unit 6: Stem Modifications and Branching Patterns Stems are modified for storage and mechanical support. Branching patterns include monopodial and sympodial growth.
Unit 7: Leaf Structure and Modifications Leaves originate from the stem and show variations in types, phyllotaxy, venation, shape, and size. They may be modified for protection, storage, or support.
Unit 8: Leaf Surface Features and Area Leaves have specific surface features and appendages that affect transpiration and photosynthesis. Leaf surface area influences productivity.
Unit 9: Flower and Fruit Structure The flower is a modified shoot involved in reproduction. It shows different types of inflorescence. Fruits develop from flowers and are classified based on structure and origin.
Unit 10: Classification and Structure of Tissues Plant tissues are classified into simple and complex tissues. Simple tissues perform basic functions, while complex tissues are involved in transport.

Unit 11: Secretory Tissues and Vascular Bundles Secretory tissues include glands, resin ducts, mucilage ducts, and laticifers. Vascular bundles consist of xylem and phloem for transport.
Unit 12: Meristem and Its Functions Meristems are regions of active cell division. They are classified into types based on position and function, contributing to plant growth.
Unit 13: Leaf Anatomy Leaves may be dorsiventral, isobilateral, or centric. Dicot and monocot leaves show structural differences, including specialized Kranz anatomy in some plants.
Unit 14: Cambium and Its Activity Cambium is responsible for secondary growth. Its activity varies seasonally and contributes to the thickening of stems.
Unit 15: Secondary Growth in Plants Secondary growth occurs mainly in dicot stems and involves formation of secondary tissues. Monocots show limited or modified secondary growth.
PRACTICALS: Anther: wall and its ontogeny; tapetum Stem: Monocot: *Zea mays;* Dicot: *Helianthus*; Secondary: *Helianthus*. Root: Monocot: *Zea mays*; Dicot: *Helianthus*; Secondary: *Helianthus* Study different types of placentation Study of types and ultra structure of mature embryo sac. Study of pollen morphology of available plants. Pollen germination test- *In vitro* germination using sugar solution Pollen viability: tetrazolium test. Six different types of ovules Endosperm: dissections of developing seeds for free-nuclear endosperm with haustoria; types(permanent slides). Female gametophyte through permanent slides/ photographs.

Suggested Books:

Singh, V.P., Pandey, P.C. and Jain, D.K. 2011. A Text book of Botany- Angiosperms. Rastogi Publication, Merrut.

Trivedi, P.C., Sharma, N. and Dhankad, R. S. 2009. Plant Morphology and Anatomy. Ramesh Book Depot. Jaipur

Sporne, K.R. 1974. Morphology of Angiosperms. Hutchinson University Press, London

Cuttler, E.G. 1971. Plant Anatomy. Part III Organs, Edward Arnold Ltd., London.

Cuttler, E.G. 1969. Plant Anatomy. Part I Cells and Tissue. Edward Arnold Ltd., London

Pandey, S.N. and Chadha, A. 2014. A text book of Botany- Plant anatomy and Economic Botany. Vikas publishing house Pvt. Ltd, New Delhi.

Vashishta, P.C. 1974. Plant Anatomy. Pradeep Publication, Jalandhar

Digital Reference:

http://courses.washington.edu/bot113/summer/LabExercises/Vegmorphhigh.pdf
http://herba.msu.ru/shipunov/school/biol_154/textbook/intro_botany.pdf
https://www.biology-pages.info/P/PlantTissues.html
http://www.phschool.com/science/biology_place/biocoach/plants/tissue.html
https://www.biologydiscussion.com/shoot-system/top-3-theories-of-shoot-apical-meristem-plants/69015

Course Name: GENETICS AND PLANT BREEDING	Course Code: UGBOT303
Semester: 5	Core / Elective: Core
Teaching Scheme in Hrs (L:T:P):	Credits: 4
Type of course: Lecture+ Assignments	Total Contact Hours: 12
Continuous Internal Evaluation:	ESE:

Course Outcomes: Upon successful completion, the student will be able
CO1: Describe the fundamental principles of genetics, Mendelian laws, and the role of DNA in inheritance.
CO2: Apply knowledge of chromosome structure and variation to explain inheritance patterns.
CO3: Analyze the effects and types of mutations and their role in inheritance of traits.
CO4: Evaluate plant breeding methods and theories such as heterosis and inbreeding depression.
CO5: Design plant improvement strategies using biotechnology and tissue culture techniques.

Unit 1: History and Foundations of Genetics
Genetics began with the work of Gregor Mendel, who established the basic principles of inheritance through his experiments. These studies laid the foundation for modern genetics.

Unit 2: DNA as Genetic Material
DNA is the hereditary material responsible for transmitting genetic information. It has specific properties such as replication, stability, and ability to store information.

Unit 3: Genetic Mechanisms and Experimental Genetics
Genetic mechanisms explain how traits are inherited and expressed. Experimental genetics studies gene behavior and variation through controlled experiments.

Unit 4: Structure and Types of Chromosomes
Chromosomes are structures that carry genetic information. They vary in type and structure in prokaryotic and eukaryotic organisms.

Unit 5: Chromosomal Organization and Artificial Chromosomes
Chromosome architecture differs between organisms. Artificial chromosomes are constructed for research and genetic engineering applications.

Unit 6: Chromosomal Theory and Structural Variations
The chromosomal theory of inheritance explains the role of chromosomes in heredity. Variations in chromosome structure include deletions, duplications, inversions, and translocations.

Unit 7: Mutation and Its Classification
Mutations are changes in genetic material. They are classified based on origin, nature, and effect, including pre-adaptive and post-adaptive mutations.

Unit 8: Inheritance of Characters
Qualitative traits are controlled by single genes, while quantitative traits involve multiple genes. These differences influence inheritance patterns.

Unit 9: Gene Interaction and Multiple Alleles
Gene interactions affect trait expression and include various types such as epistasis. Multiple alleles exist for a single gene, as seen in classical examples.

Unit 10: Introduction and Scope of Plant Breeding
Plant breeding involves improving crop varieties through selection and hybridization. It has a wide scope in agriculture and food production.

Unit 11: Heterosis and Inbreeding Depression
Heterosis refers to hybrid vigor, while inbreeding depression results in reduced fitness. Various theories explain these phenomena.

Unit 12: Domestication and Acclimatization Domestication, introduction, and acclimatization are processes that improve plant varieties and adapt them to new environments.
Unit 13: Tissue Culture and Cloning Tissue culture techniques involve growing plant cells in controlled conditions. Callus formation, suspension cultures, and cloning are key methods.
Unit 14: Regeneration and Somatic Techniques Plants can regenerate from cultured cells. Techniques include somatic embryogenesis, anther culture, and somatic hybridization.
Unit 15: Advanced Culture Techniques Meristem, ovary, and embryo culture are used for plant improvement. Cryopreservation helps in long-term storage of genetic material.
PRACTICALS: Introduction to microscopy-simple and compound microscope. Preparation and use of fixatives and stains. Preparation of micro slides and identification of various stage of cell division. Study and detection of linkage in f_2 and test cross progeny. Demonstration of structural Aberrations and polyploidy. Identification of plants of different ecological groups. Floral biology of different crop plants. T.S. of ovary. Mounting of different types of ovules. Study of typical plant cell. Emasculation and hybridization techniques in important self and cross pollinated crops. Study of male sterility in sorghum/bajra. Calculation of mean, range, variance and standard deviation.

Suggested Books:

Gupta P.K.2004. Cytology, Genetics and evolution. Rastogi Publications, Meerut. (Hindi Edition)
Kaushik, M.P.2003. A text Book of Modern Botany. Prakash publications,Muzaffar nagar(UP)
Klug, W.W.AndCummings, M.R.2005.Concepts of genetics Pearson Education (Singapore) pvt. Ltd., Indian Branch, PratapGanj,New Delhi.
Eldon GohnGardner,MichaelJ.Simmons,D.PeterSnustad.Atext book of principles of gentics

Digital References:

https://youtu.be/2avnn4repyi
https://nptel.ac.in/courses/102/104/102104052/
https://youtu.be/m0T2miip8jo
https://www.britannica.com/science/plant-breeding
https://www.easybiologyclass.com/mutation-breeding-technique-for-the-improvement-of-crop-plants-with-ppt/

Course Name: Complex Analysis	Course Code: UGMAT311
Semester: 6	Core / Elective: Core
Teaching Scheme in Hrs (L:T:P):	Credits: 4
Type of course: Lecture+ Assignments	Total Contact Hours: 12
Continuous Internal Evaluation:	ESE:

Course Outcomes: The completion of the course will enable the students:
CO1: Explain the foundational concepts of complex numbers, analytic functions, and the Cauchy-Riemann equations, and identify conditions for differentiability and harmonicity.
CO2: Apply Cauchy's theorems, integral formulas, and properties of analytic functions to solve problems involving complex integration and evaluation of real integrals.
CO3: Analyze convergence properties of power series and construct Taylor and Laurent series expansions of analytic functions within their radius of convergence.
CO4: Classify singularities and evaluate residues to apply the residue theorem in computing complex and real definite integrals.
CO5: Demonstrate the concept of conformal mappings and implement bilinear and elementary transformations to study geometric properties of complex functions.

Unit 1: Complex Numbers and Complex Plane
This unit introduces complex numbers and highlights their importance in mathematics and applications. It explains the complex plane and discusses concepts such as connected and compact sets, providing a geometric and topological foundation for complex analysis.

Unit 2: Complex Functions and Continuity
This unit focuses on complex-valued functions and their properties, including limits and continuity. It explains differentiability in the complex domain and introduces the concept of analytic functions as functions that are differentiable in a neighborhood.

Unit 3: Cauchy-Riemann Equations and Harmonic Functions
This unit explains the Cauchy-Riemann equations in both Cartesian and polar forms as necessary conditions for analyticity. It also introduces harmonic functions and discusses the distinction between analytic and holomorphic functions.

Unit 4: Complex Line Integrals and Indefinite Integrals
This unit introduces complex line integrals and explains their evaluation along curves in the complex plane. It also discusses the concept of indefinite integrals in complex analysis.

Unit 5: Cauchy's Theorems and Integral Formula
This unit focuses on Cauchy's integral theorem and Cauchy's integral formula. It highlights their significance in evaluating integrals and understanding properties of analytic functions.

Unit 6: Advanced Theorems in Complex Analysis
This unit discusses Morera's theorem, maximum and minimum modulus principles, and Liouville's theorem. It also includes the fundamental theorem of calculus in the context of complex functions, emphasizing their role in analysis.

Unit 7: Convergence of Power Series
This unit introduces power series and explains different types of convergence, including absolute and uniform convergence. It highlights conditions required for convergence of series in the complex domain.

Unit 8: Theorems on Series Expansion
This unit discusses Abel's theorem, Taylor's theorem, and Laurent's theorem. It explains how analytic functions can be expanded into series representations.

Unit 9: Radius and Circle of Convergence
This unit explains the Cauchy-Hadamard theorem and discusses the concept of radius and circle of convergence. It highlights their importance in determining the domain of validity of power series.

Unit 10: Singularities and Zeros of Analytic Functions This unit introduces singularities and zeros of analytic functions. It explains types of singularities and discusses the uniqueness (identity) theorem, along with the concept of branch points.
Unit 11: Special Classes of Functions and Theorems This unit discusses meromorphic and entire functions and introduces important results such as Riemann's theorem and the Casorati-Weierstrass theorem. It highlights their significance in understanding function behavior near singularities.
Unit 12: Residues and Applications This unit explains residues at singularities and Cauchy's residue theorem. It includes applications in evaluating real integrals and introduces the argument principle and Rouche's theorem for determining zeros of functions.
Unit 13: Conformal Mapping and Properties This unit introduces conformal mapping and explains its properties in preserving angles. It highlights the importance of conformal mappings in transforming complex domains.
Unit 14: Bilinear Transformations This unit discusses bilinear (Möbius) transformations and their properties. It explains how these transformations map circles and lines in the complex plane.
Unit 15: Elementary Transformations This unit focuses on elementary mappings such as (w(z) = \frac{z + 1/z}{2}), (z^2), (e^z), (\sin z), (\cos z), and (\log z). It explains their geometric effects and applications in complex analysis.

Suggested Books:

1. Brown J.W. and Ruel Churchill V., (2009), Complex Variables and Applications, 8th Edition, McGraw– Hill International Edition.
2. Kasana H.S., (2005), Complex Variables: Theory and Applications, 2nd Edition, PHI Learning Pvt. Ltd.
3. Bak J. and Newman D.J., (1997), Complex Analysis, 2nd Edition, Undergraduate Texts in Mathematics, Springer-Verlag New York, Inc., New York.
4. Ponnusamy S., (2014), Foundation of complex analysis, 2nd Edition, Narosa Publishing House, Delhi.

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Course Name: Metric Spaces	Course Code: UGMAT314
Semester: 6	Core / Elective: Core
Teaching Scheme in Hrs (L:T:P):	Credits: 4
Type of course: Lecture+ Assignments	Total Contact Hours: 12
Continuous Internal Evaluation:	ESE:

Course Outcomes: After studying this course, the student will be able to
CO1: Understand the concept of metric and pseudo-metric spaces using standard examples such as Euclidean, discrete, and normed spaces.
CO2: *Explain* the concepts of open and closed balls, neighbourhoods, and *analyse* the topological structure of metric spaces using interior, limit points, closure, and density.
CO3: *Apply* the notions of convergence and Cauchy sequences in metric and sub metric spaces, and *determine* whether a space is complete through examples.
CO4: *Examine* the continuity of functions between metric spaces using the sequential criterion and other definitions, and *distinguish* between continuity, uniform continuity, and homeomorphism.
CO5: *Explore* the notions of compactness and connectedness in metric spaces and *justify* their importance through examples and theorems.

Unit 1: Definition and Examples of Metric Spaces
This unit introduces metric spaces, including their definition and fundamental properties. It explains common examples such as the usual metric, Euclidean spaces with different norms, and the discrete metric space, providing a foundation for understanding distance in abstract spaces.

Unit 2: Pseudo Metric Spaces and Boundedness
This unit discusses pseudo metric spaces and highlights how they differ from metric spaces. It also explains the concept of boundedness in metric spaces with suitable examples, emphasizing the idea of distance constraints within a set.

Unit 3: Properties and Applications of Metric Spaces
This unit focuses on the general properties of metric spaces and their applications. It integrates various examples to demonstrate how metric spaces are used in analysis and topology.

Unit 4: Open and Closed Balls and Neighbourhoods
This unit introduces open and closed balls and explains the concept of neighbourhoods in metric spaces. It forms the basis for defining open sets and understanding local properties of spaces.

Unit 5: Open Sets and Interior Points
This unit explains open sets and the concept of interior of a set. It emphasizes how openness is defined using neighbourhoods and its importance in topology.

Unit 6: Closed Sets and Related Concepts
This unit discusses limit points, closed sets, diameter of a set, and dense sets. It highlights the relationships between these concepts and their role in analyzing the structure of metric spaces.

Unit 7: Sequences in Metric Spaces
This unit introduces sequences in metric spaces and explains their behavior using the concept of convergence. It provides a basis for analyzing limits in abstract spaces.

Unit 8: Subspaces and Cauchy Sequences
This unit discusses subspaces of metric spaces and introduces Cauchy sequences. It explains how convergence can be studied using internal properties of sequences.

Unit 9: Complete Metric Spaces
This unit focuses on complete metric spaces and provides examples. It explains the significance of completeness in ensuring convergence of Cauchy sequences.

Unit 10: Continuous Mappings and Sequential Criterion
This unit introduces continuous mappings in metric spaces and explains the sequential criterion for continuity. It also discusses alternative characterizations of continuity.

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Unit 11: Uniform Continuity This unit explains uniform continuity and distinguishes it from ordinary continuity. It highlights its importance in analysis and its stronger conditions.
Unit 12: Homeomorphism This unit introduces homeomorphism and explains its role in identifying topological equivalence between spaces. It emphasizes structure-preserving transformations.
Unit 13: Compactness in Metric Spaces This unit introduces compactness and explains its significance in metric spaces. It discusses properties and implications of compact sets in analysis.
Unit 14: Connectedness in Metric Spaces This unit explains connectedness and its role in understanding the structure of metric spaces. It highlights how connected sets cannot be separated into disjoint open subsets.
Unit 15: Applications of Compactness and Connectedness This unit integrates the concepts of compactness and connectedness and explains their applications in analysis. It emphasizes their importance in solving problems related to continuity and convergence.

Suggested Books:

1. Murrey R.S., (1965), Laplace Transforms (SCHAUM Outline Series), McGraw Hill.
2. Lokenath D., Bhatta, D., (2014), Integral Transforms and Their Applications, Taylor and Francis.
3. John M.W., (2011), Integral Transforms in Applied Mathematics, Cambridge University Press.
4. Davies B., (2012)., Integral Transforms and Their Applications, Springer New York, NY.
5. Hildebrand F.B., (1992), Methods of Applied Mathematics, Dover Publications.

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Course Name: Electromagnetic Theory	Course Code: UGPHY311
Semester: 6	Core / Elective: Core
Teaching Scheme in Hrs (L:T:P):	Credits: 4
Type of course: Lecture+ Assignments	Total Contact Hours: 12
Continuous Internal Evaluation:	ESE:

Course Outcomes:
CO1: Apply and solve electrostatic problems using Gauss's law, Poisson's and Laplace's equations, and the method of images for various charge configurations.
CO2: Analyze and evaluate magnetostatic fields and forces using Biot–Savart law, Ampere's law, and vector potentials, including energy and boundary value problems.
CO3: Understand and explain Maxwell's equations, electromagnetic induction, multipole expansions, and electrostatics in dielectric media with boundary conditions.
CO4: Analyze and interpret plane electromagnetic wave propagation, dispersion, polarization phenomena, and guided wave structures.
CO5: **Apply and evaluate** dynamics and radiation of relativistic charged particles using Lagrangian and Hamiltonian formulations and compute emitted radiation properties.

Unit 1: Fundamental Laws of Electrostatics
This unit introduces Gauss's law and its applications in determining electric fields. It explains Laplace and Poisson equations and their significance in electrostatics, along with the concept of scalar potential. It also discusses surface charge distributions, dipoles, and the discontinuity in electric field and potential.

Unit 2: Electrostatic Boundary Conditions and Potentials
This unit focuses on boundary value problems in electrostatics and the behavior of electric fields at interfaces. It explains how Laplace's equation is applied to solve problems involving different geometries and boundary conditions.

Unit 3: Method of Images and Applications
This unit deals with the method of images and its applications, including problems involving a point charge near grounded conducting spheres, insulated conducting spheres, spheres at fixed potential, and conducting spheres in a uniform electric field.

Unit 4: Basic Laws of Magnetostatics
This unit covers Biot–Savart law, Ampere's law, and the differential equations of magnetostatics. It explains vector potential and magnetic induction for a circular current loop and localized current distributions.

Unit 5: Magnetic Effects and Energy
This unit focuses on magnetic moment, force, torque, and energy of a localized current distribution in an external magnetic field. It also introduces macroscopic equations and boundary conditions on magnetic fields B and H.

Unit 6: Energy Flow and Conservation Laws
This unit explains methods of solving boundary value problems in magnetostatics and introduces Poynting's theorem. It discusses conservation of energy and momentum for systems of charged particles and electromagnetic fields.

Unit 7: Maxwell's Equations and Potentials
This unit explains Maxwell's equations in free space and linear isotropic media along with boundary conditions at interfaces. It covers vector and scalar potentials, gauge transformations, Lorentz gauge, Coulomb gauge, and Lorentz transformations, including transformation of electric and magnetic fields.

Unit 8: Multipole Expansion and Dielectric Media This unit introduces multipole expansion and the energy of a charge distribution in an external field. It explains electrostatics of macroscopic media, dielectric behavior, and boundary value problems involving dielectrics.
Unit 9: Polarization and Energy in Dielectrics This unit focuses on molar polarizability, electric susceptibility, and electrostatic energy in dielectric media, highlighting their physical significance and applications.
Unit 10: Plane Waves and Wave Equations This unit explains plane electromagnetic waves in non-conducting media and free space. It discusses wave equations, dispersion characteristics of dielectrics, conductors, and plasmas, and wave propagation in conducting or dissipative media.
Unit 11: Wave Properties and Interactions This unit covers superposition of waves, group velocity, and the causal connection between electric displacement and electric field through Kramers–Kronig relations. It also explains reflection, refraction, polarization, Fresnel's laws, interference, coherence, and diffraction.
Unit 12: Advanced Wave Concepts and Applications This unit discusses scalar and vector potentials, dispersion relations in plasma, transmission lines, and waveguides, emphasizing practical applications in communication systems.
Unit 13: Relativistic Motion of Charged Particles This unit introduces the Lagrangian and Hamiltonian formulation for a relativistic charged particle in electromagnetic fields. It explains covariance of equations of motion, Euler–Lagrange equations, and motion in uniform and non-uniform electric and magnetic fields, including adiabatic invariance.
Unit 14: Radiation from Moving Charges This unit focuses on radiation emitted by moving charges and dipoles, including the concept of retarded potentials and Liénard–Wiechert potentials for a point charge.
Unit 15: Radiation Power and Distribution This unit explains the total power radiated by an accelerated charge using Larmor's formula and its relativistic generalization. It also discusses angular distribution of radiation and radiation emitted by charges in highly relativistic motion.

Suggested Books:
J.D. Jackson: Classical Electrodynamics, 2nd edition, John Wiley, 2007.
D.J. Griffith: Introduction to Electrodynamics, 3rd edition, Pearson Pub., New Delhi, 2003
Panofsky and Phillips: Classical Electricity and Magnetism,2nd edition, Addison Wesley, 2012.
L.D. Landau and E.M. Lifshitz: Classical Theory of Field, 4th edition, Pergamon Press, 2003.
L.D. Landau and E.M. Lifshitz: Electrodynamics of Continuous Media, Pergamon Press, 1995.
J.R. Reitz, F.J. Milford R.W. Christry: Foundation of Electromagnetic Theory, 4th edition, Pearson Education, 2009.

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Course Name: Atomic and Molecular Physics	Course Code: UGPHY312
Semester: 5	Core / Elective: Core
Teaching Scheme in Hrs (L:T:P):	Credits: 4
Type of course: Lecture+ Assignments	Total Contact Hours: 12
Continuous Internal Evaluation:	ESE:

Course Outcomes:
CO1: Understand and explain quantum states of electrons in atoms, including spin, spectra of simple atoms, and relativistic energy corrections.
CO2: Analyze and interpret hyperfine structures, line broadening, coupling schemes, and magnetic/electric field effects on atomic spectra.
CO3: Explain and apply principles of nuclear magnetic resonance, chemical shifts, Frank-Condon principle, and Born-Oppenheimer approximation to molecular systems
CO4: Analyze electronic, rotational, vibrational, and Raman spectra of diatomic molecules using selection rules and spectral characteristics.
CO5: Understand and evaluate laser principles, including emission processes, population inversion, rate equations, resonator modes, and coherence properties.

Unit 1: Quantum States and Electron Spin
This unit introduces quantum states of an electron in an atom and explains the concept of electron spin. It highlights how quantum numbers define the state of an electron and their significance in atomic structure.

Unit 2: Atomic Spectra of Helium and Alkali Atoms
This unit focuses on the spectral characteristics of helium and alkali atoms. It explains the energy level structure and transitions responsible for their observed spectra.

Unit 3: Relativistic Corrections in Hydrogen Atom
This unit explains relativistic corrections to the energy levels of the hydrogen atom, including fine structure effects arising due to relativistic motion and spin-orbit interaction.

Unit 4: Hyperfine Structure and Coupling Schemes
This unit covers hyperfine structure and isotopic shift in atomic spectra. It also explains LS coupling and JJ coupling schemes used to describe interactions between angular momenta in atoms.

Unit 5: External Field Effects on Spectra
This unit discusses the effects of external fields on atomic spectra, including Zeeman effect, Paschen-Bach effect, and Stark effect, explaining their impact on spectral line splitting.

Unit 6: Line Broadening and Electron Spin Resonance
This unit explains the width of spectral lines due to various broadening mechanisms and introduces electron spin resonance as a technique to study magnetic properties of electrons.

Unit 7: Nuclear Magnetic Resonance
This unit introduces nuclear magnetic resonance and explains its basic principles and applications in studying molecular structure.

Unit 8: Chemical Shift and Franck-Condon Principle
This unit explains the concept of chemical shift in spectroscopy and the Franck-Condon principle, which describes electronic transitions in molecules.

Unit 9: Born-Oppenheimer Approximation
This unit discusses the Born-Oppenheimer approximation and its significance in separating electronic and nuclear motion in molecules for simplifying quantum mechanical calculations.

Unit 10: Electronic and Vibrational Spectra
This unit explains electronic and vibrational spectra of diatomic molecules, including transitions between energy levels and their spectral representation.

Unit 11: Rotational Spectra and Selection Rules This unit focuses on rotational spectra of diatomic molecules and explains selection rules governing allowed transitions.
Unit 12: Raman Spectra of Diatomic Molecules This unit covers Raman spectra, explaining its principles, differences from infrared spectra, and selection rules applicable to diatomic molecules.
Unit 13: Emission Processes and Einstein Coefficients This unit explains spontaneous and stimulated emission processes and introduces Einstein A and B coefficients, which describe transition probabilities.
Unit 14: Optical Pumping and Population Inversion This unit discusses optical pumping, population inversion, and rate equations, which are essential for achieving laser action.
Unit 15: Resonator Modes and Coherence This unit explains modes of optical resonators and the concept of coherence length, highlighting their importance in determining laser beam properties.
Practical's: Study of hydrogen spectrum. Determination of phase transition temperature of liquid crystal and Identification of mesophases. Analysis of band spectrum of PN molecule. Analysis of rotational spectrum of nitrogen. Analysis of rotational vibrational spectrum of a diatomic molecule (HBr). Absorption spectrum of $KMnO_4$. Determination of dielectric constant. Determination of dipole moment of organic liquid must be performed.

Suggested Books:

Banwell, C.N. and McCash, E.M., Fundamentals of molecular spectroscopy, Tata McGraw Hill, (2007).

Concepts of Modern Physics by Arthur Beiser (McGraw-Hill Book Company, 2002).

Atomic spectra & atomic structure, Gerhard Hertzberg: Dover publication, New York, 2003.

Molecular structure & spectroscopy, G. Aruldhas; Prentice – Hall of India, New Delhi, 2007.

Fundamentals of molecular spectroscopy, Colin N. Banwell & Elaine M. McCash, Tata McGraw – Hill publishing company limited, 1994.

Spectra of diatomic molecules by Gerhard Herzberg, 1989.

Course Name: Molecular Spectroscopy	Course Code: UGCHM311
Semester: 6	Core / Elective: Core
Teaching Scheme in Hrs (L:T:P):	Credits: 4
Type of course: Lecture+ Assignments	Total Contact Hours: 12
Continuous Internal Evaluation:	ESE:

Course Outcomes:
CO1: Students will be able to understand the concept of vibrational spectroscopy.
CO2: Students will be able to understand the concept of nuclear magnetic resonance spectroscopy (^{1}H and ^{13}C NMR) & its applications.
CO3: Students will be able understand the basic concept of electron spin resonance spectroscopy (ESR).
CO4: Students will be able to study the X-ray diffraction technique.
CO5: Students will be able to study the mass spectrometry& to identify organic compounds by IR and NMR spectra.

Unit 1: Fundamentals of Molecular Vibrations
This unit introduces the classical equation of vibration and explains vibrational energies of diatomic molecules along with the concept of zero-point energy. It discusses how molecular vibrations are quantized and their significance in spectroscopic analysis.

Unit 2: Force Constants and Anharmonicity
This unit focuses on the computation of force constants and bond strengths, providing insight into molecular stability. It also explains anharmonicity, Morse potential, and dissociation energies, highlighting deviations from ideal harmonic behavior.

Unit 3: Vibrational Spectral Features
This unit deals with fundamental frequencies, overtones, and hot bands in vibrational spectra. It also explains the breakdown of the Born–Oppenheimer approximation and its implications in spectroscopy.

Unit 4: Basic Principles of NMR
This unit covers the fundamental concepts of nuclear magnetic resonance, including nuclear spin, nuclear resonance, and saturation. It explains how nuclei interact with an external magnetic field to produce NMR signals.

Unit 5: Proton NMR Spectroscopy (^{1}H NMR)
This unit focuses on the basic instrumentation of ^{1}H NMR spectroscopy and explains shielding and deshielding effects. It discusses chemical shift and its measurement, coupling constants, and factors affecting chemical shift. It also covers spin–spin interactions and spin decoupling.

Unit 6: Carbon-13 NMR Spectroscopy (^{13}C NMR)
This unit introduces ^{13}C NMR spectroscopy and explains its principles and applications. It also covers Fourier Transform NMR (FT-NMR) techniques and their advantages in spectral analysis.

Unit 7: Principles and Instrumentation of ESR
This unit introduces electron spin resonance spectroscopy, explaining its basic principles and instrumentation. It highlights how unpaired electrons interact with magnetic fields to produce ESR signals.

Unit 8: Spectral Features and Splitting
This unit explains zero field splitting and Kramer's degeneracy. It also covers hyperfine coupling structure and its role in interpreting ESR spectra.

Unit 9: Applications of ESR Spectroscopy
This unit focuses on the applications of ESR spectroscopy, particularly in the study of transition metal complexes and their electronic structures.

Unit 10: Fundamental Concepts of X-ray Diffraction This unit explains Bragg's condition and Miller indices, providing the basis for understanding crystal structure determination using X-ray diffraction techniques.
Unit 11: Methods of X-ray Analysis This unit discusses important experimental methods such as Laue's method, Bragg's method, and Debye–Scherrer method used for structural analysis of crystals.
Unit 12: Crystal Structure Determination This unit focuses on indexing reflections and identifying unit cells from systematic absences in diffraction patterns, enabling determination of crystal structures.
Unit 13: Principles and Instrumentation of Mass Spectrometry This unit introduces mass spectrometry, explaining ion production, ion analysis, and ion abundance. It also discusses factors affecting fragmentation of molecules.
Unit 14: Fragmentation Patterns and Rearrangements This unit focuses on mass spectral fragmentation of organic compounds, including common functional group fragmentation, molecular ion peak, metastable peak, and McLafferty rearrangement.
Unit 15: Structural Determination Using Mass Spectra This unit explains the nitrogen rule and provides examples of fragmentation patterns of organic compounds for structure determination. It emphasizes interpretation of spectra in identifying molecular structures.

Suggested Books: 1.Dr. H. Kaur, Spectroscopy, Third Edition, Pragati Edition. 2.Dr. Y. R. Sharma, Organic Spectroscopy, S. Chand Publication. 3.Benwell, Molecular Spectroscopy Digital References: 1.https://sci.tanta.edu.eg/files/Introduction%20Molecular%20Spectroscopy%20BSc-Lect%20-1.pdf 2.**https://youtu.be/ciLweNjfCHY**

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Course Name: Coordination Chemistry and Radiochemistry	Course Code: UGCHM312
Semester: 6	Core / Elective: Core
Teaching Scheme in Hrs (L:T:P):	Credits: 4
Type of course: Lecture+ Assignments	Total Contact Hours: 12
Continuous Internal Evaluation:	ESE:

Course Outcomes:
CO1: Student will be able to get the knowledge of the various concepts and theoretical principles and are aware of their manifestations.
CO2: Student will be able to compare all basic analytical, qualitative and quantitative laboratory techniques and demonstrate meticulousness in operation.
CO3: Student will be able to analyze of the importance of working with safety and consciousness in laboratory and actively seeks information about health and environmental safety of chemicals that are used in the laboratories and follows protocols for their safe disposal.
CO4: Student will be able to Good knowledge of the chemical properties and nuclear characteristics of the most important Radionuclides.
CO5: Student will be able to study (based on their radioactive emissions) for nuclear fisson prcesses & can evaluate analytically & separations of radionuclides.

Unit 1: Fundamental Theories and Nomenclature of Coordination Compounds
This unit introduces Werner's theory and valence bond theory, including inner and outer orbital complexes. It explains the electro neutrality principle and the concept of back bonding. The unit also covers IUPAC nomenclature of coordination compounds and different types of isomerism observed in these compounds.

Unit 2: Stereochemistry and Stability of Complexes
This unit focuses on the stereochemistry of coordination compounds with coordination numbers 4 and 6. It explains the chelate effect, as well as the concepts of labile and inert complexes, highlighting their stability and reactivity.

Unit 3: Crystal Field Theory and Advanced Concepts
This unit explains crystal field theory and the measurement of crystal field stabilization energy in weak and strong fields. It covers pairing energy, factors affecting the magnitude of 10 Dq in octahedral and tetrahedral complexes, tetragonal distortions, Jahn-Teller theorem, and square planar geometry. It also introduces qualitative aspects of ligand field theory and molecular orbital theory.

Unit 4: Limitations of Crystal Field Theory and Introduction to MO Theory
This unit discusses the limitations of crystal field theory and introduces molecular orbital theory as an advanced approach to understanding metal-ligand bonding. It also provides an introduction to ligand field theory.

Unit 5: Bonding in Coordination Complexes
This unit explains bonding in octahedral, tetrahedral, and square planar complexes using molecular orbital theory. It highlights the nature of σ and π bonding between metal ions and ligands.

Unit 6: π-Bonding and Advanced Bonding Concepts
This unit focuses on π-bonding in coordination compounds and its explanation through molecular orbital theory. It emphasizes the role of π-donor and π-acceptor ligands in determining the stability and properties of complexes.

Unit 7: Chemistry of Lanthanides
This unit covers the general chemistry of lanthanides, including their stable oxidation states, lanthanide contraction, absorption spectra, and magnetic properties. It also discusses methods of separation and important uses of lanthanides and their compounds.

Unit 8: Chemistry of Actinides This unit explains the chemistry of actinides, including their stable oxidation states, actinide contraction, separation methods, and applications of actinides and their compounds.
Unit 9: Super Heavy Elements This unit introduces super heavy elements, focusing on their chemistry, synthesis, and unique properties in comparison with lanthanides and actinides.
Unit 10: Nuclear Structure and Binding Energy This unit introduces nuclear binding energy, mass defect, and average binding energy per nucleon. It explains the stability of nuclei based on these concepts.
Unit 11: Radioactivity and Nuclear Transformations This unit covers radioactivity, nuclear emissions, and nuclear transformations. It also explains the kinetics of radioactive decay and units used to measure radioactivity.
Unit 12: Artificial Isotopes and Detection This unit focuses on artificial isotopes and introduces radiation detector signals used in radio chemistry for measurement and analysis of radioactive substances.
Unit 13: Nuclear Reactions and Fission Process This unit explains the bombardment of nuclei by slow neutrons and the process of nuclear fission, particularly the fission of uranium. It highlights the production of energy in nuclear fission.
Unit 14: Nuclear Fuel Cycle and Reprocessing This unit covers the nuclear fuel cycle, including nuclear reprocessing and the synthesis of trans-uranium elements. It explains their importance in nuclear energy production.
Unit 15: Environmental Radiochemistry and Isotope Separation This unit discusses environmental aspects of radiochemistry, including the separation of radioactive isotopes and their impact on the environment and human health.

Suggested Books:

1.Introduction to Radiopharmaceuticals, Chapter-1, Peter Scott, Michael Kilbourn, 21 December 2020
2.Production of Radionuclides, Chapter-2, Peter Scott, Michael Kilbourn, 21 December 2020
3.Synthetic Methods for Radiopharmaceuticals, Chapter-3, Peter Scott, Michael Kilbourn, 21 December 2020

Digital References:

1.https://mis.alagappauniversity.ac.in/siteAdmin/dde-admin/uploads/2/PG_M.Sc._Chemistry_344%2021_Inorganic%20Chemistry-II_MSc%20Chemistry.pdf
2.**https://www.youtube.com/live/kgivurcr5XI?feature=share**

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Course Name: Python Programming	Course Code: UGCSA212
Semester: 6	Core / Elective: Core
Teaching Scheme in Hrs (L:T:P):	Credits: 4
Type of course: Lecture+ Assignments	Total Contact Hours:
Continuous Internal Evaluation:	ESE:

Course Outcomes: This course will enable the students to learn:

CO1. Understand and Implement Basic Python Syntax and Control Structures
CO2. Manipulate and Utilize Python Data Structures and Functions
CO3. Apply Object-Oriented Programming Principles in Python
CO4. Perform File Handling Operations and Utilize Python Modules
CO5. Explore and Implement Advanced Python Topics Including Regular Expressions, Database Connectivity, and Data Visualization

Unit 1: Basics of Python and Environment Setup

This unit introduces the concept of programming languages with a focus on Python, including its history, features, limitations, and major applications. It explains the installation of Python, setting up path and environment variables, running Python programs, writing the first Python program, and using the interactive help feature. It also highlights differences between Python and other programming languages.

Unit 2: Data Types and Input/Output Operations

This unit covers Python keywords, identifiers, statements, indentation, and documentation practices. It explains variables, multiple assignments, and different data types along with type conversion. It also introduces input and output functions and the use of the import command.

Unit 3: Operators and Expressions

This unit focuses on operators in Python and their use in forming expressions. It explains operator precedence, associativity, and non-associative operators, helping in understanding how expressions are evaluated.

Unit 4: Control Structures in Python

This unit explains decision-making statements such as conditional statements and various looping constructs. It also covers Python control statements used to alter the flow of execution.

Unit 5: Python Native Data Types

This unit introduces built-in data types including numbers, lists, tuples, sets, and dictionaries. It explains their properties, operations, and usage in programs.

Unit 6: Strings and Dictionary Methods

This unit focuses on strings in detail, including their operations and methods. It also covers functions and methods associated with dictionaries, emphasizing their practical applications.

Unit 7: Functions in Python

This unit introduces functions, their advantages, and different types such as built-in, user-defined, and anonymous functions. It explains parameter passing, recursion, and scope and lifetime of variables.

Unit 8: Modules and Their Usage

This unit explains the concept and need for modules, creation of modules, importing modules, and path searching. It also discusses module reloading and the use of standard modules.

Unit 9: Python Packages

This unit focuses on Python packages, their structure, and importance in organizing large programs. It explains how packages are used to manage modules efficiently.

Unit 10: Exception Handling in Python

This unit introduces exceptions, built-in exceptions, and techniques for handling errors. It also explains the creation and use of user-defined exceptions.

Unit 11: File Handling and Directory Management This unit covers file operations such as opening, reading, writing, and closing files. It explains file attributes, encoding, methods like tell() and seek(), and operations such as renaming and deleting files. It also introduces directory handling in Python.
Unit 12: Object-Oriented Programming Concepts This unit explains the concept of object-oriented programming in Python, including designing classes, creating objects, accessing and modifying attributes, built-in class attributes, garbage collection, and object destruction.
Unit 13: Introduction to External Libraries This unit introduces third-party modules and packages, including installation and usage of libraries such as NumPy and Pandas. It highlights their importance in data analysis and scientific computing.
Unit 14: NumPy and Pandas for Data Handling This unit focuses on NumPy for array creation, manipulation, indexing, slicing, broadcasting, aggregation, and random number generation. It also explains Pandas data structures like Series and DataFrame, along with data manipulation techniques such as selection, filtering, and merging.
Unit 15: Data Visualization using Matplotlib This unit introduces data visualization concepts and explains how to plot graphs and charts using Matplotlib, enabling graphical representation of data for analysis and interpretation.
List of Practical: Familiarization with Python environment: Installing Python, setting up the development environment, writing and executing a basic Python script Input and output: Taking user input, performing arithmetic operations, and printing the output. Basic syntax and control flow: Writing programs using variables, data types, operators, conditional statements (if, elif, else). Concepts of Iteration (For and while): Basic Iteration, range () function, nested loops, string manipulation. Working with lists: Creating lists, indexing, slicing, and using list methods. Working with tuples: creating and its methods. Manipulating dictionaries: Creating dictionaries, accessing, and modifying elements. Functions: Defining functions, using parameters, return statements Object-Oriented Programming: Defining classes and creating objects, using attributes and methods. NumPy and Pandas: Import, array creation, array indexing, array manipulation, Series and DataFrame creation, Data Inspection and Selection, Data Cleaning and grouping. Matplotlib: Import, Line Plots, Scatter Plots, Bar Plots, Histograms, Pie Charts.

Course Name: Introduction to Data Science	Course Code: UGCSA204
Semester: 6	Core / Elective: Core
Teaching Scheme in Hrs (L:T:P):	Credits: 4
Type of course: Lecture+ Assignments	Total Contact Hours:
Continuous Internal Evaluation:	ESE:

Course Outcomes: This course will enable the students to learn:

CO1. Understand and explain fundamental concepts of data science.
CO2. Collect, clean, and preprocess data for analysis.
CO3. Perform exploratory data analysis (EDA) using visualization tools.
CO4. Execute data wrangling and feature engineering techniques.
CO5. Apply data science methods to real-world applications and case studies.

Unit 1: Fundamentals and Scope of Data Science
This unit introduces data science, including its definition, scope, history, and evolution. It highlights the interdisciplinary nature of data science and its growing importance in modern decision-making processes.

Unit 2: Data Science Process and Applications
This unit explains the data science process, including problem identification, data collection, analysis, and interpretation. It also discusses various real-world applications and case studies demonstrating the impact of data science.

Unit 3: Tools and Technologies for Data Science
This unit covers essential tools and technologies used in data science, including programming languages such as Python and R, and database management using SQL. It emphasizes their role in data handling and analysis.

Unit 4: Data Types and Data Collection
This unit introduces different types of data and their sources. It explains various data collection techniques and methods used to gather relevant and reliable data for analysis.

Unit 5: Data Cleaning and Handling Missing Values
This unit focuses on data cleaning processes, including identifying and handling missing values and inconsistencies. It emphasizes the importance of preparing high-quality data for accurate analysis.

Unit 6: Data Transformation and Integration
This unit discusses data transformation, integration, and reduction techniques. It highlights methods used to convert raw data into a structured format suitable for analysis.

Unit 7: Descriptive Statistics and Univariate Analysis
This unit explains descriptive statistical measures and univariate analysis techniques used to summarize and understand individual variables in a dataset.

Unit 8: Bivariate and Multivariate Analysis
This unit focuses on analyzing relationships between two or more variables using bivariate and multivariate analysis methods. It highlights their importance in identifying patterns and correlations.

Unit 9: Data Visualization Techniques
This unit introduces data visualization tools such as Matplotlib and Seaborn. It explains how graphical representations help in understanding data patterns and communicating insights effectively.

Unit 10: Data Wrangling Techniques
This unit explains techniques for handling and transforming raw data into a usable format. It emphasizes the importance of data wrangling in preparing datasets for analysis.

Unit 11: Feature Engineering and Selection
This unit covers feature engineering, including creation and selection of relevant features. It highlights the importance of feature selection in improving model performance.

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Arvind Kumar Singh
Director

Unit 12: Tools and Libraries for Data Processing This unit introduces tools and libraries such as Pandas and NumPy used for data manipulation and analysis. It explains their applications in efficient data processing.
Unit 13: Applications in Various Domains This unit discusses real-world applications of data science in fields such as business, healthcare, finance, and social media. It highlights the practical impact of data-driven decision-making.
Unit 14: Case Studies in Data Science This unit presents case studies demonstrating how data science techniques are applied to solve real-world problems. It emphasizes practical understanding and problem-solving approaches.
Unit 15: Ethical Considerations and Future Trends This unit explains ethical issues in data science, including data privacy, bias, and responsible use of data. It also discusses emerging trends and future directions in the field of data science.
List of Practical: Familiarization with Data Science Environment: Setting up and navigating through data science tools (Python, R, SQL). Implementing Data Science Workflow: Implementing the basic data science process on a sample dataset. Data Collection Techniques: Collecting data from various sources using Python libraries. Data Cleaning: Handling missing values and outliers in a dataset. Data Transformation: Transforming and normalizing data for analysis. Descriptive Statistics: Calculating summary statistics for a dataset. Data Visualization Techniques: Creating various types of plots using Matplotlib and Seaborn. Data Wrangling: Handling and transforming raw data using Pandas. Feature Engineering: Extracting and selecting features for a machine learning model. Analyzing a Real-World Data Science Application: Applying data science techniques in business, healthcare, or finance.

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Course Name: Immunology	Course Code: UGZOO311
Semester: 6	Core / Elective: Core
Teaching Scheme in Hrs (L:T:P):	Credits: 4
Type of course: Lecture+ Assignments	Total Contact Hours: 12
Continuous Internal Evaluation:	ESE:

Course Outcomes: Upon successful completion, the student will be able to
CO1: Explain immune system fundamentals, including innate vs. adaptive immunity and their roles in host defense.
CO2: Analyze immune cell development, lymphoid organ functions, and B-cell/T-cell activation mechanisms.
C03: Evaluate antigen/antibody properties, epitopes, monoclonal antibodies, and their diagnostic applications.
CO4: Assess antigen presentation pathways, cytokine functions, and complement system roles.
CO5: Apply immunological concepts to hypersensitivity, autoimmunity, vaccines, and gene therapy.

Unit 1: Basic Concepts in Immunology
Immunology is the study of the body's defense mechanisms against foreign substances and pathogens. It involves understanding how the immune system recognizes and responds to antigens. Basic concepts include immunity, antigen recognition, and the distinction between self and non-self, which are essential for maintaining health.

Unit 2: Components of the Immune System
The immune system consists of various components including cells, tissues, and molecules that work together to protect the body. These include white blood cells, lymphoid organs, and soluble factors such as antibodies and cytokines. Each component plays a specific role in detecting and eliminating pathogens.

Unit 3: Innate and Adaptive Immunity
The immune system is divided into innate and adaptive immunity. Innate immunity provides immediate, non-specific defense through barriers and immune cells, while adaptive immunity is specific and involves memory, allowing for a stronger response upon repeated exposure to pathogens.

Unit 4: Haematopoiesis and Immune Cells
Haematopoiesis is the process of formation of blood cells in the bone marrow. It gives rise to various immune cells such as lymphocytes, macrophages, and granulocytes. These cells play distinct roles in immune responses, including pathogen recognition and elimination.

Unit 5: Lymphoid Organs and Their Functions
The immune system includes primary lymphoid organs such as bone marrow and thymus, where immune cells develop and mature, and secondary lymphoid organs such as lymph nodes and spleen, where immune responses are initiated. These organs provide the environment for immune cell activation and interaction.

Unit 6: Macrophages and Activation of B and T Cells
Macrophages are key immune cells involved in phagocytosis and antigen presentation. Activation of B cells leads to antibody production, while T cells are involved in cell-mediated immunity. The coordinated activation of these cells ensures an effective immune response.

Unit 7: Properties of Antigens and Epitopes
Antigens are substances that trigger an immune response. Their basic properties determine their immunogenicity. B cell and T cell epitopes are specific regions of antigens recognized by immune cells. Haptens are small molecules that become antigenic when attached to larger carriers, while adjuvants enhance immune responses.

Unit 8: Structure and Classes of Antibodies Antibodies are proteins produced by B cells that specifically bind to antigens. They have a characteristic structure with variable and constant regions. Different classes of antibodies perform specialized functions in immunity, such as neutralization and opsonization.
Unit 9: Monoclonal Antibodies and Applications Monoclonal antibodies are identical antibodies produced from a single clone of cells. Antigen-antibody interactions are widely used as tools in research and diagnosis, enabling detection and quantification of specific molecules in biological samples.
Unit 10: Major Histocompatibility Complex and Antigen Presentation The major histocompatibility complex plays a crucial role in presenting antigens to T cells. Antigen processing occurs through exogenous and endogenous pathways, enabling the immune system to recognize external and internal threats.
Unit 11: Cytokines and Their Functions Cytokines are signaling molecules that regulate immune responses by facilitating communication between cells. They influence cell growth, differentiation, and activation, playing a central role in coordinating immune functions.
Unit 12: Complement System The complement system consists of a group of proteins that enhance immune responses by promoting pathogen destruction and inflammation. It functions through a cascade of reactions that lead to cell lysis and opsonization.
Unit 13: Hypersensitivity, Autoimmunity, and Immunodeficiency Hypersensitivity reactions are exaggerated immune responses that can cause tissue damage and are classified into different types. Autoimmunity occurs when the immune system attacks self-tissues, while immunodeficiency results from impaired immune function, increasing susceptibility to infections.
Unit 14: Infectious Diseases and Immune Response Infectious agents such as bacteria, viruses, and parasites cause diseases by invading the body and evading immune defenses. The adaptive immune response develops over time to eliminate pathogens and provide long-term protection.
Unit 15: Vaccines, Diagnosis, and Gene Therapy Vaccines stimulate the immune system to provide protection against specific diseases. Diagnostic techniques help in identifying diseases based on immune responses. Human gene therapy involves modifying genetic material to treat diseases, representing an advanced application of immunology in medicine.
PRACTICALS: Identification and Enumeration of Blood Cells Using Hemocytometer Preparation and Staining of Blood Smear for Differential Leukocyte Count Antigen-Antibody Interaction: Ouchterlony Double Diffusion Technique Radial Immunodiffusion for Quantitative Estimation of Immunoglobulins Widal Test for Detection of Typhoid Antibodies Enzyme-Linked Immunosorbent Assay (ELISA) for Antibody Detection Isolation and Viability Testing of Lymphocytes from Blood Determination of ABO and Rh Blood Groups by Agglutination Reaction

Suggested Books:

Kindt, T. J., Goldsby, R. A., Osborne, B. A., Kuby, J. (2006). VI Edition. Immunology. W.H. Freeman and Company.

Delves, P. J., Martin, S. J., Burton, D. R., Roitt, I.M. (2006). XI Edition. Roitt's Essential Immunology, Blackwell Publishing.

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Course Name: Embryology and Teratology	Course Code: UGZOO312
Semester: 6	Core / Elective: Core
Teaching Scheme in Hrs (L:T:P):	Credits: 4
Type of course: Lecture+ Assignments	Total Contact Hours: 12
Continuous Internal Evaluation:	ESE:

Course Outcomes: Upon successful completion, the student will be able to

CO1: Explain teratology principles including genetic factors, critical periods, and dose-response relationships in fetal development.

CO2: Evaluate teratogen effects on human and animal models, placental transport mechanisms, and reproductive toxicology.

CO3: Describe chick embryogenesis stages from fertilization through tubulation and demonstrate through laboratory observations.

CO4: Analyze chick embryo developmental progression and explain extra-embryonic membrane formation and functions.

CO5: Investigate pesticide and chemical effects on avian development through toxicity studies and environmental impact assessment.

Unit 1: Introduction to Teratology and Genetic Factors

Teratology is the study of abnormal development and congenital malformations in embryos and fetuses. General principles of teratology include the role of genetic factors in determining susceptibility to developmental defects. Genetic makeup influences how organisms respond to environmental insults, making heredity an important factor in teratogenesis.

Unit 2: Critical Periods and Mechanisms of Abnormal Development

The critical period refers to specific stages of embryonic development during which the organism is most sensitive to teratogenic agents. Initiating mechanisms of teratogenesis involve disruption of cellular processes such as cell division, differentiation, and migration. These disturbances can lead to structural and functional abnormalities in developing tissues and organs.

Unit 3: Dose-Response Relationship and Consequences

The effects of teratogens depend on the dose-response relationship, where the severity of abnormalities increases with exposure level. Access of teratogens to the embryo and fetus is influenced by factors such as placental transfer. Consequences of abnormal development include malformations, growth retardation, and functional deficits, highlighting the importance of controlled exposure.

Unit 4: Teratogens and Their Effects

Teratogens are agents that cause developmental abnormalities in embryos. These include chemical, physical, and biological agents studied in both humans and experimental animals. Understanding specific examples of teratogens helps in identifying risks and preventing exposure during pregnancy.

Unit 5: Transport and Biotransformation of Xenobiotics

Xenobiotics are foreign substances that can cross the placenta or extra-embryonic membranes and affect the developing embryo. Their transport and biotransformation determine their toxicity and impact on development. These processes influence how substances are metabolized and eliminated.

Unit 6: Reproductive Toxicology in Males and Females

Reproductive toxicology studies the effects of harmful substances on reproductive systems. In

females, it involves the hypothalamus and ovary and assessment of reproductive functions. In males, it includes the biology of reproduction and evaluation of reproductive capacity. These studies are essential for understanding fertility and reproductive health.
Unit 7: Fertilization and Early Development Chick embryogenesis begins with reproduction and formation of the fertilized egg, whose structure and chemical composition support development. Cleavage involves rapid cell division that transforms the zygote into a multicellular structure, laying the foundation for further development.
Unit 8: Blastulation and Gastrulation Blastulation leads to the formation of a blastula, while gastrulation reorganizes cells into distinct germ layers. These stages are crucial for establishing the basic body plan and initiating differentiation processes in the embryo.
Unit 9: Neurulation and Tubulation Neurulation is the process by which the neural tube forms, giving rise to the central nervous system. Tubulation involves the formation of tubular structures in the developing embryo, contributing to organ development and functional organization.
Unit 10: Stages of Chick Development Chick development is studied according to hours of incubation, providing a detailed timeline of embryonic changes. Each stage reflects specific developmental events that contribute to the formation of tissues and organs.
Unit 11: Extra-Embryonic Membranes Extra-embryonic membranes in chick include structures that support and protect the developing embryo. These membranes play roles in nutrition, respiration, and waste removal, ensuring proper development outside the mother's body.
Unit 12: Developmental Significance of Extra-Embryonic Structures The development and function of extra-embryonic membranes are essential for successful embryogenesis. They facilitate exchange of gases and nutrients and protect the embryo from environmental stress, highlighting their biological importance.
Unit 13: Toxicity Studies in Chick Embryos Avian teratology involves studying the effects of toxic substances on chick embryos. Acute oral toxicity studies and dietary toxicity studies assess the impact of chemicals on development. These studies help in evaluating safety and risk of exposure.
Unit 14: Endocrine Disruptors and Embryotoxicity Endocrine disruptors interfere with hormonal regulation and can cause developmental abnormalities. Embryotoxicity studies examine the effects of industrial chemicals on chick embryos, providing insights into mechanisms of toxicity.
Unit 15: Effects of Pesticides on Poultry Pesticide residues can have physiological and biological effects on poultry, affecting growth, reproduction, and health. Understanding these effects is important for ensuring food safety and environmental protection.
PRACTICALS: Study of gametogenesis: Spermatogenesis and oogenesis in vertebrates (slides/micrographs) Observation of cleavage stages and blastula formation in frog or fish embryos Demonstration of gastrulation stages in chick embryo using whole mounts or models Dissection and study of 24-hour, 48-hour, and 72-hour chick embryos Identification of developmental stages in frog/chick embryo through permanent slides Induction and fate mapping experiments using chick embryo (virtual/simulation-based) Examination of teratogenic effects of common agents (alcohol, nicotine, drugs) on model organisms (literature/simulated data)

Preparation of karyotype to study chromosomal abnormalities linked to teratogenesis (Down's syndrome, Turner's syndrome)

Suggested Books:

Developmental Biology: Scott F. Gilbert;Sinauer Associates,Inc.Publishers
An Introduction to Embryology: B.I.Balinsky: Thomson Brooks

Course Name: REPRODUCTIVE BIOLOGY OF ANGIOSPERM	Course Code: UGBOT311
Semester: 6	Core / Elective: Core
Teaching Scheme in Hrs (L:T:P):	Credits:4
Type of course: Lecture+ Assignments	Total Contact Hours: 12
Continuous Internal Evaluation:	ESE:

Course Outcomes: Upon successful completion, the student will be able

CO1: Describe the history and development of reproductive structures in angiosperms.
CO2: Apply concepts of ovule and gametophyte development to explain pollination mechanisms.
CO3: Analyze fertilization and incompatibility systems in flowering plants.
CO4: Evaluate embryo and endosperm development and their functional roles.
CO5: Design models explaining seed dispersal, polyembryony, and fruit maturation.

Unit 1: History, Scope, and Reproductive Development

Plant reproductive biology has developed through contributions of scientists like Strasburger, Nawaschin, and Maheshwari. It includes the study of flowering induction, where the flower is considered a modified determinate shoot, and the process of flower development.

Unit 2: Structure and Development of Pollen

The anther contains pollen-producing tissues with a specialized wall structure. Microsporogenesis forms microspores, while microgametogenesis leads to pollen grain formation.

Unit 3: Pollen Structure and Viability

Pollen grains have a complex wall structure and include the male germ unit. Features such as NPC system, pollen wall proteins, and viability are important for fertilization. Palynology studies pollen and its applications.

Unit 4: Structure and Types of Ovule

The ovule contains the female reproductive structures and shows variations in type and special features such as aril and obturator.

Unit 5: Female Gametophyte Development

Megasporogenesis and megagametogenesis lead to the formation of the embryo sac, commonly of the Polygonum type, with a defined organization and ultrastructure.

Unit 6: Pollination and Pollen-Pistil Interaction

Pollination involves transfer of pollen and may be self or cross. Compatibility mechanisms regulate successful fertilization. Pollen tube entry and interaction with stigma and style are crucial steps.

Unit 7: Double Fertilization

Fertilization in angiosperms involves triple fusion and double fertilization, resulting in formation of embryo and endosperm.

Unit 8: Self-Incompatibility Mechanisms

Self-incompatibility prevents self-fertilization and includes types such as genetic and structural incompatibility (GSI and SSI).

Unit 9: Methods to Overcome Self-Incompatibility

Techniques such as mixed pollination, bud pollination, stub pollination, and in vitro fertilization are used to bypass incompatibility barriers.

Module 4: Embryo and Endosperm Development

Unit 10: Embryo Structure and Development

Embryos develop from the zygote and show distinct patterns in dicots and monocots.

Unit 11: Endosperm Development and Function

Endosperm provides nourishment to the developing embryo. It develops through different types and may form specialized structures like haustoria.

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Unit 12: Embryo-Endosperm Relationship The embryo and endosperm interact for nutrient transfer and proper development of the seed.
Unit 13: Seed Structure and Dispersal Seeds consist of embryo, endosperm, and seed coat. They play a vital role in propagation and are dispersed through various mechanisms.
Unit 14: Polyembryony and Apomixis Polyembryony involves multiple embryos in a seed, while apomixis is asexual seed formation. Both have significance in plant breeding.
Unit 15: Fruit Development and Maturation Fruits develop from the ovary after fertilization and undergo maturation, aiding in seed protection and dispersal.
PRACTICALS: Anther: wall and its ontogeny; tapetum Study of the different stages of anther development . Study different types of placentation Study of types and ultra structure of mature embryo sac. Study of pollen morphology of available plants. Pollen germination test- *In vitro* germination using sugar solution Pollen viability: tetrazolium test. Six different types of ovules Endosperm: dissections of developing seeds for free-nuclear endosperm with haustoria; types(permanent slides). Female gametophyte through permanent slides/ photographs. Books Suggested: Bhojwani, S.S. and Bhatnagar, S.P. (2011). The Embryology of Angiosperms, Vikas Publishing House. Delhi. 5th edition. Shivanna, K.R. (2003). Pollen Biology and Biotechnology. Oxford and IBH Publishing Co. Pvt.Ltd. Delhi. Raghavan, V. (2000). Developmental Biology of Flowering plants, Springer, Netherlands. Johri, B.M. 1 (1984). Embryology of Angiosperms, Springer-Verlag, Netherlands Davis, C.L. 1965. Systematic Embryology of Angiosperms. John Wiley, New York Maheswari, P. 1985. Introduction to Embryology of Angiosperms. Mac Graw Hill House (P) Ltd., New York

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Course Name: GYMNOSPERM AND PALEOBOTANY	Course Code: UGBOT312
Semester: 6	Core / Elective: Core
Teaching Scheme in Hrs (L:T:P):	Credits: 4
Type of course: Lecture+ Assignments	Total Contact Hours: 12
Continuous Internal Evaluation:	ESE:

Course Outcomes: Upon successful completion, the student will be able

CO1: Describe the general features, classification, distribution, and affinities of Gymnosperms.

CO2: Illustrate the morphology, anatomy, and reproductive cycle of Cycas.

CO3: Analyze the structural and reproductive features of Pinus and relate them to Gymnosperm adaptation.

CO4: Evaluate the ecological and economic importance of Ephedra with reference to its life history traits.

CO5: Design a timeline integrating fossil types, key genera (e.g., Rhynia, Psilophyton) and Birbal Sahni's contributions to palaeobotany.

Unit 1: General Characteristics and Distribution

Gymnosperms are non-flowering seed plants with naked seeds. They are mostly woody, evergreen plants distributed in temperate and cold regions.

Unit 2: Classification and Affinities

Gymnosperms are classified based on systems such as K. R. Sporne (1965). They show affinities with pteridophytes in reproductive features and with angiosperms in seed development.

Unit 3: Economic Importance of Gymnosperms

Gymnosperms are important for timber, resin, medicinal uses, and ecological balance. They contribute significantly to forestry and industry.

Unit 4: General Characteristics and Morphology

Cycadales are palm-like plants with large compound leaves and thick stems. They show primitive features among gymnosperms.

Unit 5: Anatomy and Reproduction

The anatomy includes well-developed vascular tissues. Reproduction involves large cones and distinct male and female structures.

Unit 6: Life Cycle of Cycas

The life cycle includes alternation of generations with dominant sporophyte and specialized reproductive structures.

Unit 7: General Characteristics and Morphology

Coniferales include tall trees like Pinus with needle-like leaves adapted to cold climates.

Unit 8: Anatomy and Reproduction

They have well-developed vascular systems and reproduce through cones with separate male and female structures.

Unit 9: Life Cycle of Pinus

The life cycle shows alternation of generations with dominant sporophyte and seed formation.

Unit 10: General Characteristics and Morphology

Ephedrales are gymnosperms with jointed stems and reduced leaves. They are adapted to arid environments.

Unit 11: Anatomy and Reproduction

They show advanced features such as vessel elements in xylem. Reproduction involves cone-like structures.

Unit 12: Life Cycle and Importance of Ephedra The life cycle includes typical gymnosperm features. Ephedra has ecological importance and medicinal uses.
Unit 13: Fossils and Geological Time Scale Palaeobotany studies plant fossils and their evolution through geological time. Fossils provide evidence of ancient plant forms.
Unit 14: Fossil Plants and Their Significance Plants like Rhynia, Psilophyton, Glossopteris, Cycadeoids, Cordaites, and Pentoxylon represent important stages in plant evolution.
Unit 15: Contribution of Birbal Sahani Birbal Sahani made significant contributions to palaeobotany in India, especially in the study of fossil plants and their classification.
Practicals: *Cycas*- Morphology (coralloid roots, bulbil, leaf), whole mount of microsporophyll, transverse section of coralloid root, transverse section of rachis, vertical section of leaflet, vertical section of microsporophyll, whole mount of spores (temporary slides), longitudinal section of ovule, transverse section of root (permanent slide). *Pinus*- Morphology (long and dwarf shoots, whole mount of dwarf shoot, male and female cones), transverse section of Needle, transverse section of stem, longitudinal section of /transverse section of male cone, whole mount of microsporophyll, whole mount of Microspores. Study of Morphology, anatomy and reproductive structures of Fossil Pteridophytes: Rhynia, Lepidodendron, Lepidostrobus, Lepidocarpon, Calamites and Sphenophyllum Types of Fossils and Rocks, Techniques to study fossils. Study of representative genera: Lygenopteridaceae, Medullosaceae, Cycadeoideaceae, Williamsoniaceae, Glossopteridaceae, Pentoxylaceae, and Cordaitaceae. Study of morphology, anatomy and reproductive structures: Zamia, Encephalartos, Ginkgo, Cedrus, Araucaria, Podocarpus, Thuja, Biota, CupressusTaxodium, Juniperus, Cryptomeria, Gnetum, Ephedra and Welwitschia.

Text books

Pandey, S.N., Mishra, S.P. and Trivedi, P.S. 1981. A text book of Botany vol. II, Vikas publishing House Pvt. Ltd, New Delhi.
Bhatnagar, S.P. &Moitra, A. (1996). Gymnosperms. New Age International (P) Ltd Publishers,New Delhi,
Parihar, N.S. (1991). An introduction to Embryophyta: Vol. I. Bryophyta. Central Book Depot.Allahabad.
Vasishtha, PC. 2004. Gymnosperms Vol.V. S. Chand & Co., Delhi.
Bhatnagar, SP and Moitra, A. 1996. Gymnosperms. New Age Internl Pvt. Ltd., New Delhi.
Moitra, A. 2003. Gymnosperms. New Age International (P) Ltd.
Stewart, WN and Rathwell, GW. 1993. Paleobotany and the Evolution of plants. Cambridge University Press, Cambridge.

Centre for Distance and Online Education-VGU
Arvind Kumar Singh
Director

For Vivekananda Global University, Jaipur
Registrar

5.3 Duration of Programme

Programme	Level	Duration	Maximum duration for completion	Credits
B.Sc. (Combination of three subjects)	UG	3 years	6 years	123 Credits

5.4 Faculty and support staff requirement

Academic Staff	Number available to meet the required delivery norms
Programme Coordinator	1
Course Coordinator	1
Course Mentor	1

Administrative staff strength

Admin and other support staff	Number required in HEI Campus
Deputy Registrar	1
Assistant Registrar	1
Section Officer	1
Assistants	2
Computer Operators	2
Multi-Tasking Staff	2

***Note: - This administrative requirement will the common for all the programmes.**

5.5 Instructional delivery mechanisms

After identifying the needs, requirement, preferences and expectations of learners and meeting out the regulatory requirement and its recommendation we have selected the appropriate type of instructional delivery mechanism for the content development of the programme, keeping in mind the pedagogical principles, methods, and strategies that will support the learning process. Self-learning material (SLM) will be prepared by in-house by the faculty of the Vivekananda Global University where content is prepared to fulfil the learning objectives and program outcomes. The prepared learning material will be hosted through learning management platform (LMS) of university and provision for circulation of printed copies is also available to facilitate the knowledge sharing. In content development process coverage of course syllabus, mapping of

content to assessment criteria, and proper feedback mechanisms is followed by University however Learner are advised to make use of the reference books in the list of books mentioned with the syllabus and also go through all the addition reference material in form of e-books, pre-recorded a/v content.

Personal Contact Programme (PCP): There will be a personal contact programme for a minimum duration of 12 days for 4 credit course (1 hour each day). A minimum of 12 days for instruction by experienced and scholarly faculties **of the conventional mode of the University, faculties of CDOE department and subject matter expert** will be arranged for each course of the programme. There shall be interaction built around lectures, discussions, individual and group activities. Proper evaluation to be conducted for checking the **learners'** understandings at the end of the personal contact programme.

5.6 Identification of media-print, audio, or video, online, computer aided

Along with conduction of PCPs in physical mode and availability of Self learning material in printed version, Academic delivery will be hosted through the Learning Management Platform. LMS provides for all the learning materials which consists of e- learning material in form of downloadable PDFs, reference link, practice quizzes, and other pre-recorded audio-visual learning content. Dashboard will give the progress of their learning, regular notifications regarding Assignments, personal contact program and Examinations. It also provides an opportunity for raising queries if any, and seek answers to the same by course coordinators and mentors.

5.7 Student Support Services

Students would have the access to connect with university team for support services in case of any queries during the learning process. A complete grievance mechanism process including a google form is available on the CDOE website. This would help the learner to connect with the university team for support services. A help desk for students would help the students to call / email and connect with our support team or communicate through ticketing system.

6 Procedure for Admission, Curriculum Transaction and Evaluation

The proposed Programme in ODL mode will be conducted by CDOE-VGU with the support of various departments of the University. Eligibility criteria, course structure, detailed curriculum, duration of Programme and evaluation criteria shall be approved by Board of Studies and Academic Council, VGU, Jaipur which are based on UGC guidelines for the programmes which comes under the purview of ODL and Online mode for award of Degree.

Details of Procedure for admission in which eligibility criteria for admission and fee structureof the course, Curriculum includes Program delivery, norms for delivery of courses in ODL mode, use of

IT services to academic support services, course design academic calendar and Evaluation which includes Distribution ofMarks in Continuous internal assessments, Minimum Passing criteria and system of Grading formats are given in detail as under.

6.1 Procedure for Admission

Students who will seek admission in B.Sc. (Combination of three Subjects) (ODL Mode) Programme to apply through its website.

6.2 Minimum Eligibility Criteria for Admission

The minimum eligibility criteria for admission to the ODL B.Sc. (Combination of Three Subjects) programme is successful completion of the 10+2 (or equivalent) examination from any recognized board.

6.3 Programme Fee and Financial Assistance Policy

Program fees for students for proposed B.Sc. (Combination of three Subjects) in various streams offered by CDOE- VGU Jaipur is **₹54000** for the complete three years with e-SLMs (without printed study materials), and with printed study materials, the fee is **₹68,400**. The complete fee breakup is a follows:-

Sr. No.	Fee Component	First Year		Second Year		Third Year	
		I Sem	II Sem	III Sem	IV Sem	V Sem	VI Sem
1	Registration	1000	Nil	Nil	Nil	Nil	Nil
2	Tuition fee which includes the PCP conduction charges	9000	9000	9000	9000	9000	9000
3	Examination	1500	1500	1500	1500	1500	1500
4	Study materials in printed form (if required)	2400	2400	2400	2400	2400	2400
Total with study materials charges		**13900**	**12900**	**12900**	**12900**	**12900**	**12900**
Total without study materials charges		**11500**	**10500**	**10500**	**10500**	**10500**	**10500**

6.4 Curriculum Transactions

Programme Delivery

The curriculum will be delivered through the Self Learning Materials (SLMs) supported by various learning resources including audio-video aids through ICT.

Proposed Academic Calendar

1. For January session

Centre for Distance and Online Education-VGU
Arvind Kumar Singh
Director

For Vivekananda Global University, Jaipur
Registrar

Sr no	Name of the Activity	Tentative months schedule (specify months) during Year	
		From (Month)	To (Month)
1	Admission (complete process including necessary counselling)	Jan	Feb
2	Distribution of SLM (After conformation of admission)	Jan	Feb
3	Personal Contact Programmes (for academic queries, counselling, practical etc.)	April	June
2	Assignment Submission (if any)	May	June
3	Evaluation of Assignment	May	June
4	Examination	June	Jul
5	Declaration of Result	July	August
6	Re–registration	August	Sep

2. For July session

Sr no	Name of the Activity	Tentative months schedule (specify months) during Year	
		From (Month)	To (Month)
1	Admission	Jul	Sep
2	Distribution of SLM (After conformation of admission)	Jul	Sep
3	Personal Contact Programmes (for academic queries, counselling, practical etc.)	Oct	Dec
4	Assignment Submission (if any)	Oct	Nov
5	Evaluation of Assignment	Nov	Dec
6	Examination	Dec	Jan
7	Declaration of Result	Jan	Feb
8	Re–registration	Jan	Feb

6.5 Evaluation

The evaluation shall include two types of assessments- 1. continuous assessment in the form of assignments which will carry 30% weightage of total assessment value and 2. summative assessment in the form of end semester examination carry 70% weightage of total assessment value. End semester examination will be held with proctored examination tool technology and shall be conducted from university premises only.

6.5.1 Passing Minimum

The students are considered as eligible for degree if they score more than 5 CGPA and acquire requisite minimum credits.

6.5.2 Grades & Grade Points

1. At the end of the Semester / Year every student is assigned a 'Letter Grade' based on his/her performance over the semester in all courses for which he/she had registered.
2. The letter grade and grade point indicate the results of quantitative and qualitative assessment of the student's performance in a course.
3. There are seven letter grades: **O, A+, A, B+, B, C and E** that have grade points withvalues distributed on a 10-point scale. The letter grades and the corresponding grade points on the 10-point scale are as given in the following table. In addition to these, theletters in grades cards **I, W, and GA** are used which stand for Incomplete, Withdrawaland Grade Awaited, respectively. The grades for Audit Course shall be S (Satisfactory)or X (Not satisfactory).

STATISTICAL METHOD OF RELATIVE GRADING			
Lower Range of Marks	**Grade Awarded**	**Grade Point**	**Upper Range of Marks**
≥ Mean + 1.5 σ	O	10	-
≥ Mean + 1.0 σ	A+	9	< Mean + 1.5 σ
≥ Mean + 0.5 σ	A	8	< Mean + 1.0 σ
≥ Mean	B+	7	< Mean + 0.5 σ
≥ Mean - 0.5 σ	B	6	< Mean
≥ Mean - 1.0 σ	C	5	< Mean - 0.5 σ
-	E	2	< Mean - 1.0 σ
-	I (Incomplete)	0	-
-	W (Withdrawal)	0	-
-	GA (Grade Awaited)	0	-
-	S (Satisfactory)	-	-
-	X (Not Satisfactory)	-	-

7 Requirement of the Laboratory Support and Library Resources

7.1 Laboratory Support

A student desirous to complete MSc (Mathematics) Programme is supposed to perform practical's related with IT Tools, Programming in 'C' / C++/ Java and DBMS they will facilitate with computer labs, and other than that media lab and A/V studio available with the department and University will be permitted to them for free access as and when required.

For Vivekananda Global University, Jaipur

Registrar

Centre for Distance and Online Education-VGU

Arvind Kumar Singh

Director

7.2 Library Resources

CDOE-VGU has excellent library withall the books required for the course learning and reference books for the course of B.Sc. (Combination of three Subjects). Adequate online learning links and e-learning materials will also be provided to students whichwill be support students in their learning cycle.

8 Cost Estimate of the Programme and the Provisions

The Estimate of Cost & Budget could be as follows (all figures on Annual basis) :

Recurring Expenses (A)	
Number of Courses	63
Number of Counseling Sessions	10 per course
Cost Per Counselling Session	Rs.1500.00/hour/Session
Cost for all Course – Counselling Charges	15,000
Total cost of Counseling Sessions for all courses	9,45,000
Administrative Expenditure per Semester	30,000/month
Total Administrative Expenditure for the duration of the programme	18,90,000
Total Recurring Expenses (A)	**28,35,000**
Fixed Cost (B) Study Material Development	
Course Development /Course	1,20,000
Course Development for 63 courses (Writing/editing/vetting Cost)	75,60,000

9 Quality assurance mechanism and expected Programme Outcomes

The quality of the program depends on the course curriculum and syllabus which meets the requirement of the industry and creates the skillful learning in the students. The ultimate aim of M Sc. (Mathematics) program in ODL Mode is to enhance skills of the learners as managers, entrepreneurs and seeing them excel in their profession and meeting global standards too by upgrading their career opportunities.

The CDOE-VGU has constituted Centrefor Internal Quality Assurance (CIQA). The CIQA will do periodic assessment of the online learning course material and audio video tutorials and will assure that the quality of learning is maintained and time to time changes are made as per the requirement of the course. The CIQA will also access the quality of assignments, quizzes and end term assessment time to time and required changes will be assured by them to maintain the quality of the learning program. CIQA will assure that the learning is made a truly global experience for the learner along with inculcation of required skills in the learner as expected program outcome with CDOE-VGU, Jaipur.

For Vivekananda Global University, Jaipur

Registrar

Centre for Distance and Online Education-VGU

Director

The university will work continuously for the betterment of processes, assessments, teaching methodology, e-learning material improvisation as per four quadrant approach and implementation of the same as per New Education Policy. The University is committed to deliver the best education in all the learning modes with adherence to NEP, UGC and other regulatory guidelines in truly Global sense.

10 Feedback Form

To monitor quality of Student Support Services provided to the learners, it is proposed to obtain Feedback annually as per the details given below:

ACADEMIC SESSION: __

S No	Feedback Questions	Answers & Remarks
1	Your Name	
2	Your Programme	
3	Your Enrollment Number	
4	Year of Study: Mention – I, II, III, IV, V, VI Semester / 1st, 2nd , 3rd Year	
5	Your Mobile Number:	
6	Your Email ID	
7	Are you in service / employed? Mention – Yes / No	
8	Have you received your Identity Card in time? Mention - Yes / No	
9	Have you received your study material in time? Mention - Yes / No	
10	How do you rate quality of the study material? Mention - Excellent / Good / Poor:	
11	Have you attended the counselling session? Mention - Yes / No:	
12	How do you rate quality of the counselling sessions conducted? Mention - Excellent / Good / Poor:	
13	Have you submitted Assignments / Projects? Mention - Yes / No	
14	Are you satisfied with the evaluation of your Assignments / Projects? Mention - Yes / No	

For Vivekananda Global University, Jaipur

Registrar

Centre for Distance and Online Education-VGU

Director

15	Are you receiving feedback from your academic counsellors on your assignment responses? Mention – Yes / No	
16	Have you availed Library Services of VGU? Mention - Yes / No	
17	If Yes, how do you rate the quality of library services Mention - Excellent / Good / Poor	
18	Have you appeared in the examinations conducted by CDOE-VGUCDOE-VGUCDOE-VGU?	
	Mention - Yes / No	
19	If Yes, mention the quality of conduct of the examinations. Mention - Excellent / Good / Poor	
20	Are you satisfied with evaluation of your examination papers? Mention - Yes / No	
21	If No, mention reason thereof!	
22	Are you getting result in time? Mention - Yes / No	
23	Are you receiving your mark sheets in time? Mention - Yes / No	
24	Are your grievances redressed satisfactorily at CDOE-VGUCDOE-VGUCDOE-VGU? Mention Yes / No	
25	How do you rate the quality of responses given toyou at CDOE-VGUCDOE-VGUCDOE-VGU? Mention - Excellent / Good / Poor	
26	How do you rate the information given on the website about your studies? Mention - Excellent / Good / Poor	
27	Are you satisfied studying at CDOE-VGUCDOE-VGUCDOE-VGU – Yes / No	
28	Will you recommend your friends and relatives toget enrolled for ODL Programmes of VGU? Mention – Yes / No	
		2.
		3.
		4.
		5.

GENERAL REMARKSAND SUGGESTIONS FOR IMPROVEMENT: (Attach additional sheet, if required)_____

_____

Date: _____

SIGNATURE OF THE STUDENT

For Vivekananda Global University, Jaipur

Registrar

Centre for Distance and Online Education-VGU

Director