

2.6.1 Program outcomes, Program Specific outcomes, for all program offered by the institute are started and displayed on website

There are 3 programs in undergraduate level-B.A., B.Sc. and B.Com. Also, there are 5 post-graduate programs in Arts faculty, 4 post-graduate programs in Science faculty and one diploma program in computer application. Following are the program outcomes:

Program Outcomes

1. Program outcomes of Bachelor of Arts:

PO1. Knowledge and understanding of arts field: To develop a detailed knowledge and understanding of arts field as core disciplines in humanities, social sciences and languages.

PO2. Reading and writing skills: Students can interpret with an awareness and curiosity for other perspectives. They will be able to write effectively for a variety of professional and social setting. They will develop an awareness and confidence in their own voice as a writer and analyze complex social and natural problems with the help of their degree specialization.

PO3. Critical Approaches: Students will develop an ability to read works of literary, and cultural criticism and develop idea with the help of their specialization. They will express their own ideas as informed opinions, small projects and practical and understand how their own approach compares to variety of critical and theoretical approaches.

PO4. Environment Awareness: Understand the issues and problems of environmental context and develop environmental awareness in the mind.

2. Program outcomes of Bachelor of Science

PO1. Understand the methods of science, To understand the methods of science, and can explain why scientific knowledge is both contestable testable by future inquiry.

PO2. Apply appropriate methods to solve the problem A Bachelor can apply appropriate methods to solve problem in science, mathematics, technology including the planning and conduct of a significant project problem or investigation.

PO3. Articulate the relationship between different branches of science. A bachelor of science can Apply appropriate methods to solve problem , the international scope of science, mathematics, technology and engineering knowledge and methods and the contributions to their development that have been made by people with diverse perspectives, culture and backgrounds.

3. Program outcomes of Bachelor of Commerce

PO1. To apply basic mathematical and statistical skills A bachelor can apply basic mathematical operations and statistical skills necessary, which is necessary for analysis of a range of problems in economics actuarial studies, Accounting, Marketing, Management and Finance etc.

PO2. Sound knowledge of commercial, economical and taxation laws: Impact on changes of taxation, economical and commercial law to various areas of economy and practices.

PO3.Environment Awareness: Understand the issues and problems of environmental context and develop environmental awareness in the mind.

PO4.Consumer Movement: Make people aware about consumer movement, rights & duties, laws relating to consumers.

PO5. Analysis of Organizational problems A bachelor can analyze and understand the balance between real and sustainable economical development.

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4. Program outcomes of Master of Arts in Sociology

PO-1 Better understanding of real life situation: The ability to apply sociological concepts and theories to the real world and ultimately their everyday lives

PO-2 Sociological Understanding: The ability to demonstrate sociological understandings of phenomena,

PO-3 Learn about institutions, culture, social control and inequality in society - Students have the ability to learn about institutions, folkways, mores, culture, social control, social inequality, population composition, population policy, society and culture of India. All these help to instill among the students of Sociology a sense of ethical and social responsibility.

PO-4 Sociological theories- Acquiring sociological knowledge in the forms of theories and methods would make students good social scientists.

PO-5 Sociological behaviour of human The sociological knowledge provides students scientific outlooks and attitudes to understand the human behaviour, social issues and phenomena.

5. Program outcomes of Master of Arts in Political Science

PO-1 Conceptual and Analytical Skills: Students should have an advanced knowledge of the political world, including contemporary political thought, and public policies, and be able to use key concepts and analytical approaches from political science.

PO-2 Professional and Citizenship: Student knows, understands, and able to meet the expectations of professionalism and citizenship. They can demonstrate professional behavior in terms of personal presentation and ethical values.

PO-3 Develops Communication skills: Students become able to make clear and effective demonstrations of their work in writing and in public presentations.

6. Program outcome of Master of Arts in Economics

PO-1 Developing competency with the cost-benefit approach to decision-making Student can understand the various microeconomic and macroeconomic phenomena (e.g., price movements in markets for specific products, interest-rate setting by the Federal Reserve)

PO-2 Analytical problem solving- Student use relevant concepts and information to address problems. They can be able to perform relevant mathematical operations. Further, they can appropriately interpret results from the operations

PO-3 Development of written communication- Student can use clear statement of purpose. They also use clear organization and logic. They also use clear, accurate, and relevant information and concepts. They can be able to use clear and effective summary, conclusion, and/or recommendation and closing statement.

7. Program outcome of Master of Arts in Geography

PO1.Acquireing Knowledge of Physical Geography- Student gain knowledge of physical geography. They understand about the geomorphological and geotechnical process and formation. They become able to correlate the knowledge of physical geography with the human geography.

PO-2 Understand Environmental Ethics and Sustainability- Understand the impact of the acquired knowledge in societal and environmental contexts, and demonstrate the knowledge of need for sustainable development.

PO-3 Gain the Knowledge of Human Geography- They become able to acquire the knowledge of Human Geography and can correlate it with their practical life.

PO-4 Ability of Problem Analysis- Student makes able to analyze the problems of physical as well as cultural environments of both rural and urban areas. Moreover they can try to find out the possible measures to solve these problems.

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8. Program outcome of Master of Arts in Hindi Literature

PO-1 Relation between stories and society- The student can gain knowledge about the relation between the socio cultural condition of a society by the short stories.

PO-2 Consciousness about the issues related to different sections of society- The students can gain the knowledge and share of their ideas about the forms of exploitation of various categories of society and also learn about its long drawn effects in society.

PO-3 Environmental consciousness- The students can gain knowledge about the concept of 'Paryavaran' and its role in making human life healthy.

9. Program outcome of Master of Science in Chemistry

PO-1 Create an awareness of the impact of chemistry on the society, and development outside the scientific community.

PO-2 Demonstrate, solve and an understanding of major concepts in all disciplines of Chemistry.

PO-3 Solve the reaction mechanisms and assign the final product theoretically.

PO-4 Study of medicinal chemistry.

PO-5 Understanding the synthesis of natural products and drugs theoretically.

PO-6 To inculcate the scientific temperament in the students and outside the scientific community.

10. Program outcome of Master of Science in Botany

PO-1 Environment and Sustainability- Understand the issues of environmental contexts and sustainable development

PO-2 Critical Thinking- Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.

PO-3 Ethics- Recognize different value systems including your own, understand the moral dimensions of your decisions, and accept responsibility for them.

PO-4 Employment through innovative botanical ideas- Our main focus is that a student of Botany should himself not in the grip of unemployment completely, he/she should practice of mushroom cultivation lab establishment, techniques related to horticulture, manure production, hydroponics at least at domestic market level. So, he must not too much worry about the jobs after post-graduation degree.

11. Program outcome of Master of Science in Zoology

PO-1 – Anatomical structure - To gain the knowledge of anatomical structure and various metabolic functions of organisms.

PO-2 – Knowledge of one's own and social life- It helps to understand and apply the knowledge of one's own physical and social life.

PO-3 – Ethical principles- To aware students about ethical principles and commit to professional ethics and responsibilities.

PO-4 - Information and skill of advanced biological techniques for experimental purpose.

PO-5 - Understand various physiological processes at molecular level of animals from different phyla.

PO-6 - Environment Awareness - Awareness about environment and its conservation processes, pollution control and its importance.

PO-7 - Animal kingdom- Aware students about knowledge and skill in the fundamentals and systematics of animal kingdom.

PO-8 Vulnerable and endangered species - Gain knowledge of protection of vulnerable and endangered species

PO-9 Information and skill of applied zoology - Information and skill of applied zoology including sericulture, apiculture, fisheries, poultry, vermin-culture, agricultural pests and their control etc.

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PO-10 social wellbeing - Understand about various concepts of genetics and its importance in social wellbeing.

PO-11 - Knowledge of diseases- Gain knowledge of communicable and non-communicable diseases to improve personal and public health.

12. Program outcome of Master of Science in Mathematics

PO-1 Skills to analyze problems- It equip the student with skills to analyze problems, formulate an hypothesis, evaluate and validate results, and draw reasonable conclusions thereof.

PO-2 Effective Scientific and/or technical communication- Imbibe effective scientific and/or technical communication in both oral and writing.

PO-3 Prepare students for pursuing research or careers in various fields- It prepare students for pursuing research or careers in various fields of life, e.g., teaching, coaching, guidance, banking and all areas which need analytical thinking. It helps students for jobs due to its analytical approach of thinking about real-life problems.

PO-4 Inculcate critical thinking- This program inculcates critical thinking to carry out scientific investigation objectively without being biased with preconceived notions.

PO-5 Continue to acquire relevant knowledge and skills- Continue to acquire relevant knowledge and skills appropriate to professional activities and demonstrate highest standards of ethical issues in mathematical sciences.

PO-6 Create awareness to become an enlightened citizen- Create awareness to become an enlightened citizen with commitment to deliver one's responsibilities within the scope of bestowed rights and privileges

13. Program outcome of Post Graduate Diploma in Computer Application

PO-1 A sound understanding of basic computer applications in business covering key

PO-2 Post completing this course, one can make one of their choices of interest from multiple roles in many companies.

PO-3- After the successful completion of this program, one can work as:

- Software Engineer
- Computer Programmer & Analyst
- Interface Engineer
- Java Developer
- Project Manager
- Information Security Analyst
- IT Consultant

Program Specific Outcomes

Program Specific Outcomes for Sociology

PSO-1. To understand the core doctrines of each of the ideologies and to make sense of sociology through different ideological perspectives.

PSO2. Understand social structure and preliminary facts of castes and jatis, from language, religion, ethic and Economic determinants and critically assesses its impact on the society.

PSO-3. Understand legacy of the thinkers is explained with the view to establish the continuity.

2.6.1-SSR: PO, PSO, CO FOR SSR

Program Specific Outcomes for Political science

PSO-1. To understand the core doctrines of each of the ideologies and to make sense of politics through different ideological perspectives.

PSO-2. Understand social structure and preliminary facts of castes and jatis, from language, religion, ethic and Economic determinants and critically assesses its impact on the political processes.

PSO-3. Understand legacy of the thinkers is explained with the view to establish the continuity.

Program Specific Outcomes for Economics

PSO-1. Understand the difference between Micro Economics & Macro Economics.

PSO-2. Understand the techniques and diagrams related to employment theory.

PSO-3. To study the international policies of economics, and politics for economic strengthen.

PSO-4. Understand the concept of Foreign Exchange, International Banking & Euro Currency Market.

Program Specific Outcomes for Geography

PSO-1. Understand the nature and basic concept of geography

PSO-2. Understand the applied and professional nature of geography such as fields of surveying

PSO-3. Understand the application of modern geography techniques such as geographical information system in society as well as environmental and settlement geography, hazards, language land cover etc.

Program Specific Outcomes for Hindi

PSO-1. Understand basic concepts of Hindi, including Hindi grammar and Hindi literature.

PSO-2. To know in depth the knowledge of literature of Hindi

PSO-3. To know about the great writers, and their literature.

Program Specific Outcomes for Chemistry

PSO-1. Inorganic chemistry: Introduction to molecular symmetry, co-ordination of compounds and Bio-inorganic chemistry.

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PSO-2. Physical chemistry: Review of conventional processes, recent advance techniques. Surface properties, ionic properties and other special characteristics of substances,

PSO-3. Organic chemistry: Introduction to fundamental concepts and principles of process synthesis. Proficiency in Synthetic skill, Characterization by various analytical techniques, Micro-techniques and in-depth knowledge in subject is evaluated by allotting synthetic scheme.

Program Specific Outcomes for Botany

PSO-1. To study the variation of plants life at all levels of biological organization.

PSO-2. To Study biotechnological process, use of various plants resources at commercial level.

PSO-3. To understand the physiological process in plants

Program Specific Outcomes for Zoology

PSO-1. To study application of Zoology for benefit of mankind.

PSO-2. To serve as a valuable foundation for understanding human anatomy, physiology, genetics, molecular biology and entomology.

PSO-3. To study the range from diversity to Molecular Biology.

Program Specific Outcomes for Mathematics

PSO-1. To study the method of solving in mathematics.

PSO-2. To develop the calculating abilities and analyzing abilities in students.

PSO-3. The students acquire an understanding of basic object oriented concepts and the issues involved in mathematics, e.g., example solving, proving technique, analyze the concept.

Program Specific Outcomes for Computer

PSO-1. To develop “Problem Solving” abilities using computers.

PSO-2. To understand creations, manipulation and querying of data in databases.

PSO-3. To teach fundamental concepts of DBMS.

Course Outcomes

Course Outcomes of Sociology Department

S.N.	Name of Paper	Learning outcome
1	CLASSICAL SOCIOLOGICAL TRADITION	❖ Historical Background of the Emergence of Sociology. Auguste Comte, Emile Durkheim, Vilfredo Pareto, Herbert Spencer,
2	PHILOSOPHICAL AND CONCEPTUAL FOUNDATION OF RESEARCH METHODOLOGY	❖ Philosophical Roots of Social Research; Values and Theories in Sociology; Nature of Social Reality and Approaches to It; Qualitative Methods in Social Research; Issues in Social Research
3	SOCIAL CHANGE IN INDIA	❖ Conceptual and Theoretical Frame work, Factors of Social change; Trends and Processes of Change in Modern India; Changes in Tribal and Rural India; Changes in Urban and Industrial India
4	RURAL SOCIOLOGY	❖ Characteristics and Approaches; Agrarian Institutions; Planned Change; Rural Development and Change; Welfare measures and consequent Changes

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5	PRACTICAL-I	<ul style="list-style-type: none"> ❖ Practical based on Field Work & Preparation of tools ❖ Interview Guide and case study
6	CLASSICAL SOCIOLOGICAL THINKERS	<ul style="list-style-type: none"> ❖ Karl Marx; Thurstein Veblen; Max Weber; Talcott Parsons; Robert K. Merton;
7	QUANTITATIVE RESEARCH TECHNIQUES IN SOCIOLOGY	<ul style="list-style-type: none"> ❖ Sampling; Quantitative method and survey Research; Measurement and Scaling Techniques; Statistics in Social Research; Qualitative and Quantitative research method
8	SOCIOLOGY OF DEVELOPMENT	<ul style="list-style-type: none"> ❖ Perspectives on Development; Changing Conception of Human Development; Indian Experience on Development; Consequences of Development; Issues and development in Contemporary India (Social Exclusion, Gender Discrimination, Privatization and unfavorable Service condition, Sustainability)
9	INDIAN RURAL SOCIETY	<ul style="list-style-type: none"> ❖ Tribal Society as Agrarian Society; Social Issues; Contemporary Issues; Peasant Movement; Naxlite movement in Contemporary India.
10	PRACTICAL-II	<ul style="list-style-type: none"> ❖ Practical based on Field Work & Preparation of tools ❖ Questionnaire, Interview Schedule Preparation and Tabulation
11	CLASSICAL SOCIOLOGICAL THEORIES	<ul style="list-style-type: none"> ❖ Positivism; Functionalism; Conflict theory; Structuralism; Exchange Theory
12	SOCIAL MOVEMENTS IN INDIA	<ul style="list-style-type: none"> ❖ Nature and Types; Basis of Social Movement; Theoretical Perspectives; Traditional Social Movements; New Social Movements (Dalit, Women, ethnic, environmental)
13	PERSPECTIVES OF STUDY TO INDIAN SOCIETY	<ul style="list-style-type: none"> ❖ Indological / Textual; Structural Functionlism; Marxism; Subaltern Perspective; Civilization
14	INDUSTRY AND SOCIETY IN INDIA	<ul style="list-style-type: none"> ❖ Industrial Sociology and Classical Sociological Tradition; Industrial Organizations; Problems through Industrialization process; Subjective Experience of Work; Technological Change and Automation;
15	CRIMINOLOGY	<ul style="list-style-type: none"> ❖ Conceptual and Theoretical Approaches; Type of Criminals and Crime; Changing Profile of Crime and Criminals; Theories of Punishment; Terrorism
16	MODERN SOCIOLOGICAL THEORIES	<ul style="list-style-type: none"> ❖ Symbolic Interectionism; Phenomenology; Ethno methodology, Critical Theory; Post Modernism
17	COMPARATIVE SOCIOLOGY	<ul style="list-style-type: none"> ❖ Historical and Social Context of Emergence of Sociology in the West; Central Themes in Comparative sociology; Theoretical Concern,s in Comparative sociology; Current Debates; Debate on “For Sociology of India”;
18	CONTEMPORARY ISSUES IN INDUSTRY	<ul style="list-style-type: none"> ❖ Industrial Relation; Trade Union and Industrialization; Industry and Society; Industrilization in Third world Countries in the Era of Globlization; Contemporary Issues
19	CRIMINOLOGY: CORRECTIONAL AND ADMINISTRATION	<ul style="list-style-type: none"> ❖ Roots of Correction to prevent Crime; Correction and It’s Forms; Problem of Correctional Administration; Victimological Perspective; Community Policing
20	PROJECT REPORT	<ul style="list-style-type: none"> ❖ On Rural and Urban Problems

Course Outcomes of Political Science Department

S.N.	Name of paper	Learning outcome
1	Indian Political Thought	Kautilya, Swami Vivekanand And Bal Gangadhar Tilak; Thought Of Dr. Bhimrao Ambedkar, Mahatma Gandhi And Gopal Krishna Gokhle, Thought Of Raja Ram Mohan Roy, Ram Manohar Lohia, Manvendra Nath Roy, Jaiprskash Narayan, Thought Of JawarLal Nehru, Dindyal Upadhyay, Moulana Abul Kalam Azad
2	Indian Government and Politics	Background of indian constitution, organization ideological basis source, preamble, features of indian constitution; fundamental rights and dueties; union legislature; union judiciary.
3	Comparative Politics	Comparative Politics Meaning, Nature, Scope and Problems, Political System

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		Concept, Features and Importance; Approaches to the Study of Political System, Characteristics of Traditional and Modern Political Studies Political culture, Political Socialisation, Political Communication
4	International Organization	Nature and Evolution of International Organization Coordination among Nations , Nation State, and International System; League of Nation-Formation, Function, Achievements, Merits and Demerit and evaluation; United Nation-Formation Structure, Peace and Coercive Measures to Settle the Disputes in United Nations The role of UN to Social and Economic Development; Regional Organization-SAARC, ASEAN, EUROPEAN UNION, BRICS
5	Western Political Thought	Plato, Aristotle, Machiavelli; Jean Bodin, Thomas Hobbes, John Lock, Jaen Jacous rousseau; Bentham, J.S. Mill ,T.H. Green Hegel, Marx, Lenin, Mao
6	State Politics in India	State Executive: GOVERNOR, CHIEF MINISTER and Council of Ministers; state Legislature: Vidhan Sabha and Vidhan Parishad State Judiciary: High Court and Subordinate Courts; Demand for State Autonomy, Demand For the Creation of New State, Inter State River Water Disputes, Factors influencing State Politics in India; state Planning commission, State Finance Commission State Election Commission, Major Trends in State Politics of India
7	Comparative Politics of Development Countries	Classification of Government- Unitary, Federal, Parliamentary, Presidential, Federalism; Political Institutions- Legislature, executive and Judiciary, Theory of Separation of Powers; political Parties and Pressure Groups Bureaucracy- Structure Function and Role; Political Development, Political Elites, Political Socialisation, political Modernization
8	Indian Foreign Policy	Foreign Policy: Meaning, Nature and Determinants Determinants of Indian Foreign Policy: Internal and External Principles and Objectives of Indian Foreign Policy; India and the USA, India and Russia; India and Pakistan, India and China, India and Srilanka; India and the U.N.O India and Nuclear Disarmament
9	Principal of International Politics	Evolution of International Politics as discipline, Nature, Scope, Method of Study- Traditional and Scientific; Theories of International Politics, Realism Idealism, Equilibrium, Decision making, Game, communication & System Theory; Concept of Power-Elements and limitations of National Power-Balance of Power- Collective Security, New colonialism. National Interest and International Ideology and Morale; Disarmament, Nuclear Non Proliferation-CTBT NPT. Regional Organization- SAARC, ASEAN, OPEC
10	Public Administration Part-I	Public Administration-Definition, Nature, Scope, Difference between Private Administration; Approaches to Study- Behaviouralism, Comparative, Decision Making, Development Administration, New Public Administration; Theory of Organization:-Hierarchy,Unity of Command Span of Control, Delegation of Power, Coordination; Centralisation and Decentralisation, Chief Executive- Types and Role. Line and Staff Agencies, Departmental Organization, Independent Regulatory Commission; Public Corporation, Recruitment, Promotion and Training, Retirement, Union Public Service Commission, Bureaucracy
11	Research Methodology Part-I	Nature of Social Research, Importance and uses, Difference between Pure and Applied Research, Identification of Research Problem Research Design, Hypotheses Formulation and testing; Social Survey- Amis, Importance, process, Data Collection, Primary and Secondary Source of Facts; Observational Method, Interview Method, Questionnaire and Schedules; Types of Study- Panel , Case and Field Study
12	Government and Politics of Chhattisgarh	National Movement in Chhattisgarh from, 1885 to 1947; Major Social Reformist and Political Leaders; Local Self Govt. In Chhattisgarh; Tribal Area Administration in Chhattisgarh; Main Determining Factors and Features of State Politics in Chhattisgarh

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13	Contemporary issues of International Politics	Non-Alignment in International Politics Basis, Role, Importance and Relevance; Cold War and End of Cold War- Cause and results. New World Order Important issues in post cold war era- Globalisation Human Rights, Environment, Terrorism; Foreign Policy of Important Countries India, USA, China and Russia.
14	Public Administration Part-II	Personnel Administration- System to Solve the Problem of Personnel; Finance Administration; Administration Behaviour; Corruption in Administration.
15	Research Methodology Part-II	Sampling, Scaling Techniques, Projections Techniques; Research Team, Problems of Research, Classification of Facts and Tabulation ; analysis and Interpretation of Facts. Report writing Reprographic Presentation of Data; The use and limitation of Statistics. Mean Mode, Medium, and Use of computer
16	Political Ideologies and Modern Political Thought	<u>Individualism and Liberalism</u> –Concept, Main Theories Merits and Demerits. Contemporary Liberalism, Main Thinkers; <u>Existentialism</u> – Concept, Jean Paul Sartre. Fascism – Concept, Main Features. <u>Karl Popper</u> Totalitarianism – Concept – Main Features. Contemporary Liberty – Isaiah Berlin And Milton Friedman. Leo Strauss – Criticism of Democracy, Defence of Classical Political Theory. <u>Feminism</u> – Concept, Features <u>Contemporary Marxism</u> – Antonio Gramsci- Concept of Hegemony, Role of Intellectuals. <u>Frankfurt School</u> – Introduction, Criticism of All Kinds of Hegemony. <u>Socialism</u> – Concept, Features. <u>Multiculturalism</u>
17	Project work VIVA-VOCE	A project work of 100 marks

Course Outcomes of Economics Department

S.N.	NAME OF PAPER	LEARNING OUTCOMES
1	Micro economics -1 paper-1	❖ Introduction; indifference curve; theory of production; theory of cost and revenue analysis; monopolistic competition
2	Macro economics-1 paper-2	❖ National income and accounts; classical theory of employment; consumption function; investment function; demand for money.
3	Quantitative methods paper-3	❖ Skewness, simple correlation; regression analysis; interpolation and extrapolation; association of attributes, index number, time series analysis; meaning and types of functions. Differentiation and integration
4	Indian economy paper-4	❖ Indian economy: meaning, basic characteristics and major issues of development of Indian economy; demographic features of India; agricultural development in Indian economy; industrial development in India; infrastructure and economic development.
5	Industrial economics paper-5	❖ Concept and organization of a firm; industrial productivity, owned, external and other components of funds; structure of industrial labour; large scale industries;
6	Micro economics-ii paper-1	❖ Full cost pricing theory; theory of distribution; linear programming and game theory; concept of equilibrium; welfare economics.
7	Macro economics paper-2	❖ Theory of inflation; business cycles; monetary policy; IS-LM model; the rational expectation hypothesis.
8	Research methodology and computer application-paper 3	❖ Research methodology and research methods; sampling; classification and tabulation of data; testing of hypothesis; elementary knowledge of internet and ms office, role of computer in economic research.
9	Indian economic policy-paper-4	❖ Planning in India; problem of poverty and inequality, problem of unemployment in India; Indian finance system; foreign trade of India; WTO and its impact on the different sectors of economy.

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10	Labour economics-paper-5	❖ Labour economics - definition, nature, scope & importance; theories of labour market; theories of labour movement; labour legislation in Indian labour; labour welfare in India, rural and agricultural labour in India.
11	Economics of growth-paper-1	❖ Economic growth and development; the concept of capital output ratio, theories of growth; approaches to growth; steady state growth, growth accounting.
12	International trade-paper-2	❖ Theory of international trade; modern theory of international trade; the theory of intervention; balance of payments; income adjustment.
13	Public finance-paper-3	❖ Nature and scope of public finance; public expenditure; public revenue; public debt; budget – meaning, objectives, different forms of budget, budgetary process in India,
14	Environmental economics-paper-4	❖ The economics of environment; economic theory of environmental issues; population, agriculture and the environment; ecological economics; environmental value and methods
15	Demography-paper-5	❖ Theories of population; migration; mortality, fertility; women empowerment
16	Economics of development and planning-paper-1	❖ Economic planning; theories of development; approaches to development; development models; investment criteria in economic development
17	International economics-paper-2	❖ Foreign trade and economic development regionalism of European Union; theory of short term & long term capital movement and international trade; international monetary system; international organizations
18	Public economics-paper-3	❖ Role of public finance in economic development; federal finance; Indian tax system; analysis of Centre & Chhattisgarh Govt, budget; financial responsibilities and budget management act
19	Economics of social sector-paper-4	❖ Pollution- classification of pollution; development and environment; economics of resources; economics of education; health economics.
20	Viva-voce examination-paper-5	❖ To appear for a viva-voce examination before the external examiner appointed by the university

Course Outcomes of Geography Department

S.N.	Name of paper	LEARNING OUTCOME
1	Geomorphology	UNIT-1: Nature and scope of geomorphology, UNIT-2: exogenic process UNIT-3: concept of geomorphic cycle and its controversy UNIT-4: Geological structure and landforms
2	Climatology	Unit-1: Nature and scope of climatology and its relationship with meteorology. Unit-2: The application of general principles of elementary physical and synoptic meteorology Unit-3: Nature and scope of oceanography. Unit-4: Marine biological environment.
3	Geographical thought	UNIT-1: The field of geography, its place in the classification of science Unit-2: The growth of geographical knowledge UNIT-3: Scientific explanation. UNIT-4: Responses to positivism
4	Advanced Geography of India	UNIT-1: Physical and biological elements of Geography OF INDIA UNIT-2: Population distribution, Irrigation, Agriculture, Sources of power UNIT-3: Mineral resources, Industrial development, with specific reference to iron ore UNIT-4: Regional division of India, Major schemes of regions of India, Physical and cultural geography of Chhattisgarh
5	Population Geography	UNIT-1: Definition and scope of population geography Unit-2: Distribution of population Unit-3: Population composition in terms of age, sex, residence, education Unit-4: Migration of population
6	Practical	Advanced Cartography and Surveying

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		Graph and Diagram, Thematic map, Morphometric analysis, Map projection
7	Economic geography and Natural resource Management	UNIT-1: Nature and scope of economic geography UNIT-2: World pattern of major natural resource UNIT-3: Concept and technique of delimitation UNIT-4: Conservation and Management of resources
8	Settlement Geography	UNIT-1: Settlement Geography, evolution and distribution UNIT-2: Evolution and growth of urban settlement UNIT-3: General nature of city structure UNIT-4: Urban function, urban planning of India
9	Regional Development and Planning	UNIT-1: Regional planning UNIT-2: Regional development theories UNIT-3: Approaches and strategies of regional development UNIT-4: Regional planning in India
10	Remote sensing Technique	UNIT-1: Historical development UNIT-2: Image processing UNIT-3: Spatial science UNIT-4: GIS technology
11	Biography and Ecosystem	UNIT-1: Definition and scope UNIT-2: Elements of plant geography UNIT-3: ecosystem UNIT-4: Biodiversity and its conservation
12	Agriculture geography	UNIT-1: Nature and scopes UNIT-2: Determinants of agriculture land use UNIT-3: Theories of agricultural locations UNIT-4: Agriculture in India
13	Practical	Quantitative technique, Remote sensing and GIS

Course Outcomes of Hindi Department

S.N.	Name of paper	Learning outcome
1	izFke lsesLVj izulk= & izFke fgUnh lkfgR; dk bfrgkl ¼vkfndky ,oa iwoZ e/dky½	bdkbZ&1 fgUnh lkfgR; dk bfrgkl% ijEijk vkSj i)fr% bdkbZ&2 vkfndky% bdkbZ&3 iwoZ e/dky ¼HkfDr dky½] HkfDr vkanksyu bdkbZ&4 HkfDr dky dh fofHkUu dkO;-/kkjk, j
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6	f}rh; lsesLVj iz"u lk= & k'B e/dkyhu dkO;	bdkbZ &1- lwjnkI & HkzejxhR lkj bdkbZ & 2- rpylhnl bdkbZ & 3- fcgkj bdkbZ & 4- nzqr ikB gsrq fuEukafdr 5 dfo;ksa ,oa mudh jpukvks a dk ¼fo'k; ,oa f"kyixr½ Kku visf{kr gS ds"ko] Hkw'k.k] in~ekdj] nso] ?kukuan
7	f}rh; lsesLVj iz"u lk= & llre vk/kqfuddkO;&2 ¼izxfrokn] iz;ksxokn] ubZ dfork ,oa ledkyhu dfork½	l-gh-okRL;k;u vKs; x-ek- eqfDrcks/k ukxktqZu j?kqohj lgk;
8	f}rh; lsesLVj iz"u lk= & v'Ve vk/kqfud x lkfgR; ¼miU;kl] fuca/k ,oa dgkuh½	miU;kl & 1- xksnku fuca/k dgkuh
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10	r`rh; lsesLVjiz"u lk= & f}rh; ¼Hkk'kk foKku½	bdkbZ&1 Hkk'kk vkSj Hkk'kk foKku bdkbZ&2 Lou izfØ;k bdkbZ&3 O;kdj.k % :lk foKku dk Lo:lk vkSj "kk[kk, bdkbZ&4 vFkZ foKku % vFkZ dh vo/kkj.kk]
11	r`rh; lsesLVj iz"u lk= & r`rh; ¼dkedkth fgUnh ,oa i=dkfjrk½	bdkbZ&1 fgUnh ds fofHkUu :lk& bdkbZ&2 ikfjHkkf'kd "kCnkoyh bdkbZ&3 ba VjusV la idZ midj.kks a dk ifjp; bdkbZ&4 i=dkfjrk dk Lo:lk ,oa izdkj
12	r`rh; lsesLVj iz"u lk= & prqFkZ Hkkjrh; lkfgR; iw	bdkbZ&1 Hkkjrh; lkfgR; dk Lo:lk] bdkbZ&2 fgUnhrj lkfgR; dk bfrgkl bdkbZ&3 miU;kl bdkbZ& 4 ukVd & g;onu
13	prqFkZ lsesLVj iz"u lk= & iape ¼fgUnh vkykspuk rFkk leh{kk "kkL=½	bdkbZ 1 euksfo"ys"k.k okn bdkbZ 2 fgUnh dfo vkpk;ksZa dk dkO; "kkL=h; fparu bdkbZ 3 vk/kqfud fgUnh vkykspuk dk fodkl ,oa midh izeq[k izo`fRr; bdkbZ 4 O;kogkfjd leh{kk % dkO;ka" k dh Loofoosd ds vuq[kj O;k];k
14	prqFkZ lsesLVj iz"u lk= & 'k'B ¼fgUnh Hkk'kk½	bdkbZ&1 fgUnh dh ,sfrgkfld lk`BHKwfe bdkbZ&2 fgUnh dk HkkSxksfyd foLrkj bdkbZ&3 fgUnh ds fofo/k :lk& bdkbZ&4 fgUnh esa dEl;wVj lqfo/kk,
15	prqFkZ lsesLVj iz"u lk= & llre ¼ehfM;k&ys[ku ,oa vuqokn½	bdkbZ&1 ehfM;k ys[ku tulapkj bdkbZ&2 n";&JO; ek;/e bdkbZ&3 vuqokn & fl)kar ,oa O;ogkj bdkbZ&4 O;kogkfjd vuqokn vH;kl
16	prqFkZ lsesLVj iz"u lk= & v`Ve tuinh; Hkk'kk vkSj lkfgR; ¼NRrhx<+h½	bdkbZ&1 NRrhx<+h Hkk'kk&HkkSxksfyd lhek bdkbZ&2 NRrhx<+h lkfgR; dh ;qx izo`fRr;kW ,oa bfrgkl bdkbZ&3 NRrhx<+h dfork ,oa dfo bdkbZ&4 NRrhx<+h ukVd ,oa miU;kl

Course Outcomes of Botany Department

S.N.	Name of paper	LEARNING OUTCOME
1	CYTOLOGY	UNIT-I • The dynamic cells, Structural organization of the plant cell, specialized plant cell type chemical foundation, biochemical energetics. • Cell wall - Structure and functions, biogenesis growth. • Plasma membrane; structure, models and functions, site for ATPase, ion carriers channels and pumps, receptors. UNIT-II • Chloroplast-structure, genome organization, gene expression, RNA editing. • Mitochondria; structure, genome organization, biogenesis. • Plant Vacuole – Tonoplast membrane, ATPases transporters as a storage organelle. UNIT-III • Nucleus: Structure, nuclear pore, Nucleosome organization. • Ribosome- Structure and functional significance. • Cell cycle and Apoptosis; Control mechanisms, role of cyclin dependent kinases. • Retinoblastoma and E2F proteins, cytokinesis and cell plate formation, mechanisms of programmed cell death. UNIT-IV • Other cell organelles: Structure and functions of microbodies, microtubules, microfilaments, Golgi apparatus, lysosome, endoplasmic reticulum. • Techniques in cell biology: Immune techniques, in situ hybridization to locate transcripts in cell types FISH, GISH, Confocal microscopy
2	GENETICS	UNIT-I • Chromatin Organization : Chromosome structure and packaging of DNA, molecular organization of centromere and telomere, nucleolus and ribosomal RNA genes, chromatin and heterochromatin, Karyotype, banding pattern specialized types of chromosomes, polytene, lamp brush, B chromosomes and sex chromosomes. • Molecular basis of chromosome pairing chromosomal aberration and polyploidy. UNIT-II • Mapping of Bacteriophage genome, Phage phenotype, recombination in phage, genetic transformation and transduction in bacteria. UNIT-III • Genetic recombination & genetic mapping; Mechanism of crossing over, molecular mechanism of recombination, role of Rec-A, Rec-B, Rec- C and Rec-D enzymes, site specific recombination, linkage, linkage group, genetic marker. UNIT-IV • Alien gene transfer through chromosome manipulation; Transfer of whole genome examples from wheat, a rachis & brassica. Transfer of individual chromosomes & chromosome segment, methods for detecting alien chromatin, production.
3	MICROBIOLOGY, PHYCOLOGY AND MYCOLOGY	UNIT-I • Archaeobacteria and Eubacteria : General account, ultra structure, nutrition and reproduction, biology and economic importance. • Cyanobacteria : Salient feature and biological importance. UNIT-II • Viruses : Characteristics and ultra-structure of virions, isolation and purification of viruses, chemical nature, replication, transmission of viruses, economic importance. • Phytoplasma : General characteristic and role in causing plant diseases. UNIT-III • Phycology : Algae in diversified habitats (terrestrial, freshwater, marine), thallus organization, cell ultra-structure, reproduction (vegetative, asexual,sexual). • Criteria for classification of Chlorophyta, Xanthophyta, Bacillariophyta, Phaeophyta and

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		<p>Rhodophyta.</p> <ul style="list-style-type: none"> • Economic importance of algae. <p>UNIT-IV • Mycology : General characters of fungi, substrate relationship in fungi, cell structure unicellular and multicellular organization, cell wall composition, nutrition (saprobic biotrophic, symbiotic) reproduction, (vegetative, asexual, sexual) heterothallism, heterokaryosis, Para sexuality, recent account of Mastigomycotina, Zygomycotina, Ascomycotina, Basidiomycotina, Deuteromycotina, Mycorrhiza, fungi as biocontrol agent</p>
4	BRYOPHYTA,PTERIDOPHYTA AND GYMNOSPERM	<p>UNIT-I • Bryophyta : morphology, structure, reproduction, life history, distribution, classification. • General account of Marchantiales, Jungermanniales, Anthocerotales, Sphagnales, Funariales and Polytrichales. Economic and ecological importance.</p> <p>UNIT-II • Pteridophyta : morphology, anatomy and reproduction, classification, evolution of stele. • Heterospory and origin of seed habit, general account of fossil pteridophyta . • Introduction to Psilopsida, Lycopsidea, Sphenopsida and Pteropsida.</p> <p>UNIT-III • Gymnosperm : General characters of gymnosperm mentioning diversity. • Classification of gymnosperm. • Resemblances and difference amongst gymnosperm, pteridophyta and angiosperm. • Gymnosperm distribution in India. • Gymnosperm Biotechnology. • Economic importance of gymnosperm. • Origin and evolution of gymnosperm stele. • Structure and theories regarding origin of Paleozoic ovule.</p> <p>UNIT-IV • Extinct gymnosperm : general account of pteridospermales, Glossopteridales, Caytoniales, Pentoxylales. • Extant gymnosperm : Cycadales, Ginkgoales, Coniferales, Ephedrales Gnetales, and Welwitschiales.</p>
5	TAXONOMY AND DIVERSITY OF PLANTS	<p>UNIT-I • Plant nomenclature : Binomial Nomenclature, International code of Botanical nomenclature. • Plant identification : Herbaria, Botanical gardens, Taxonomic literature, Taxonomic keys. • Taxonomic hierarchy - Major categories, minor categories ,species concept. • Taxonomic evidences - Morphology, Anatomy, Palynology, Embryology, Cytology, Photochemistry, Genome analysis and Nucleic acid hybridization. • Geographical information system (GIS).</p> <p>UNIT-II • Pre Darwinian Classification Based on form relationship (Bentham and Hooker) • Post Darwinian classification Engler and Prantl, Bessey's, Hutchinson, Takhtajan and Cronquist. • Recent modifications : Dahlgren's system of classification. • Fossil angiosperm.</p> <p>UNIT-III • Study of following families with particular reference to systematic position, phylogeny, evolutionary trends and economic importance. Dicot families; Ranunculaceae, Magnoliaceae, Nymphaeaceae, Sterculiaceae, Meliaceae, Fabaceae, Cucurbitaceae, Umbelliferae, Asteraceae, Sapotaceae. Bignoniaceae, Labiatae, Verbenaceae, Euphorbiaceae, Moraceae.</p> <p>UNIT-IV • Study of following families with particular reference to systematic position, phylogeny, Evolutionary trends and economic importance, Monocot families-Orchidaceae, Zingiberaceae, Commelinaceae, Cyperaceae, Poaceae study of local available families.</p>
6	MOLECULAR BIOLOGY	<p>UNIT-I • RNA and DNA Structure. A, B and Z Forms, replication, damage and repair, transcription, translation.</p> <p>UNIT-II • Molecular Cytogenetics : Nuclear DNA content, C-value paradox, Cot curve and its Significance, restriction mapping - concept and techniques, multigene families and their evolution, in situ hybridization and techniques, chromosomes micro dissection and micro cloning, flow cytometry and confocal microscopy and karyotype analysis.</p> <p>UNIT-III • Gene structure and expression : fine structure of gene, Cis-trans test, fine structure analysis of eukaryotes, introns and their significance. RNA splicing, regulation of gene expression in prokaryotes and eukaryotes. • Protein sorting: Targeting proteins to organelles.</p> <p>UNIT-IV • Mutation: Spontaneous and induced mutation, physical and chemical mutagens molecular basis of gene, transposable elements in prokaryotes and eukaryotes, mutation induced by transposones, site directed mutagenesis, inherited human diseases and defects in DNA repair, translocation, intersect Robertsonian translocation, B-A translocation</p>
7	PLANT PHYSIOLOGY	<p>UNIT-I • Membrane transport and translocation of water and solutes: Plant-water relation, mechanism of water transport through Xylem, root microbe interaction in facilitating nutrient uptake. Comparison of xylem and phloem transport, phloem loading and unloading, passive and active solute transport, membrane transportsystem.</p>

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		<p>UNIT-II • Signal Transduction : Overview, receptors and G proteins, Phospholipids signaling, role of cyclic nucleotides, calcium-calmodulin cascade, diversity in protein kinases and phosphatases, specific signaling mechanism- two component sensor regulatory system in bacteria.</p> <p>UNIT-III • Stress physiology : Plant responses to biotic and abiotic stress, mechanism of biotic and abiotic stress tolerance, HR Fundamental and SAR, water deficit and drought resistance salinity stress, metal toxicity, freezing and heat stress, oxidative stress.</p> <p>UNIT-IV • Fundamentals of enzymology : General aspects of allosteric mechanism, regulatory & active sites, isozymes, kinetics of enzymatic catalysis, Michaelis-Menton equation and its significance. • Sensory photobiology, History of discovery of phytochromes and cryptochroms and their photo chemical and biochemical properties, photophysiology of light underresponses ,cellular localization, and molecular mechanism of action of enzyme.</p>
8	PLANT METABOLISM	<p>UNIT-I • Photosynthesis : General concepts and historical background, evolution of photosynthetic apparatus, photosynthetic pigments and light harvesting complexes, photo oxidation of water, mechanism of electron and proton transport, Carbon assimilation ,the Calvin cycle, photorespiration and its significance, the C4 cycle, the CAM pathway, biosynthesis of starch and sucrose, physiological and ecological considerations.</p> <p>UNIT-II • Respiration and lipid metabolism : Overview of plant respiration, glycolysis, Kreb cycle (TCA cycle), electron transport and ATP synthesis, Pentose phosphate pathway, alternative oxidase system, structure and function of lipids, fatty acid biosynthesis, synthesis of membrane lipids ,structural lipids and storage lipids and their catabolism Glyoxylate cycle.</p> <p>UNIT-III • Nitrogen and Sulphur metabolism : Overview, biological nitrogen fixation, nodule formation and nod factors, mechanism of nitrate uptake and reduction ,ammonium assimilation, sulphur uptake, transport and assimilation.</p> <p>UNIT-IV • Plant growth regulators and elicitors : Physiological effects and mechanism of action of auxins, gibberellins, cytokinins, ethylenes, abscisic acid, brassinosteroid, polymines ,jasmonic acid and salicylic acid, hormone receptors. • The flowering process:- Photoperiodism and its significance, endogeneous clock and its regulation, floral induction and development, Genetic molecular analysis, role of vernalization.</p>
9	PLANT DEVELOPMENT & PLANT RESOURCES	<p>UNIT-I Introduction: Unique features of plant development. Metabolism of nucleic acids, proteins and mobilization of food reserves, tropisms; control of cell division, Programmed cell death in the life cycle of plants, Seed germination, Hormonal control of Seedling growth. Seed dormancy, Over coming of seed dormancy, Bud dormancy. Root development : Organization of root apical meristem (RAM), Cell fates and lineages, Vascular tissue differentiation of root, Lateral roots, Root hairs, Root microbe interaction.</p> <p>UNIT-II Shoot development : Organization of shoot apical meristem (SAM), Cytological and molecular analysis of SAM. Control of tissue differentiation; especially Xylem and Phloem, Vascular cambium. Secretary ducts and laticifers, Wood development in relation to environmental factors.</p> <p>UNIT-III Leaf development : Development, Phyllotaxy, Control of leaf form, Differentiation of epidermis (with special reference to Stomata and Trichome) and Mesophyll cell. Senescence, Influences of hormones and environmental factors on senescence. Flower development : Floral characteristics, Flower development, Genetics of floral organ differentiation: Homeotic mutant in Arabidopsis and Antirrhinum, Sex determination.</p> <p>UNIT-IV Plant resources :Origin, Evolution, Cultivation and Uses of (i) Food, Forage and Fodder crops, (ii) Fiber crops, (iii) Medicinal and Aromatic plants, (iv) Vegetable Oil-yielding crops (v) fruits. Important fire-wood, Timber-yielding plants and Non-wood forest products (NFPs) such as bamboos, gums, tannins, dyes and resins.</p>
10	PLANT ECOLOGY- I (ECOSYSTEM AND VEGETATION ECOLOGY)	<p>UNIT-I ECOSYSTEM ORGANISATION:- Structure and functions, primary production (Methods of measurement, global pattern, controlling factors), Energy dynamics (trophic organization, energy flow pathways, ecological efficiencies), Litter fall and decomposition, (mechanism, substrate quality, and climatic factors), global biogeochemical cycles of C, N, P, and S, mineral cycles (pathways, processes and budgets) in terrestrial and aquatic ecosystems.</p> <p>UNIT-II ECOSYSTEM STABILITY AND MANAGEMENT Concept (resistance and resilience), Ecological perturbations (natural and anthropogenic) and their impact on plants and ecosystems, ecology of plant invasion, environment impact assessment, ecosystem restorations. Concept of Sustainable development, sustainability indicators.</p>

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		<p>UNIT-III VEGETATION ORGANISATION:- Concepts of community and continuum, analysis of communities (analytical and synthetic characters), Community coefficients, inter specific associations, ordination, and concept of ecological niche.</p> <p>UNIT-IV VEGETATION DEVELOPMENT :- Temporal changes (cyclic and non cyclic), mechanism of ecological succession (relay floristic and initial floristic composition, facilitation, tolerance and inhibition models), change in ecosystem properties during succession</p>
11	BIOTECHNOLOGY AND GENETIC ENGINEERING OF PLANTS AND MICROBES	<p>UNIT-I BIOTECHNOLOGY - Basic concepts, principles and scope. RECOMBINANT D.N.A. TECHNOLOGY : Gene cloning principles, Tools - Restriction Endonucleases, DNA modifying enzymes, Choice of Vectors, Plasmid, Cosmid, Bacteriophage vectors, phagmids, Artificial chromosomes. Shuttle vectors, Yeast vectors, Expression vectors and techniques, construction of genomic / cDNA libraries.</p> <p>UNIT-II MICROBIAL GENETIC MANIPULATION: Bacterial transformation, selection of recombinants and transformants, genetic improvement of industrial microbes and nitrogen fixers, fermentation technology. GENETIC ENGINEERING OF PLANTS : Aims, strategies for development of transgenies (with suitable examples), Gene transfer methods - Vector mediated gene transfer-Agrobacterium the natural genetic engineer. t-DNA mediated DNA transformation. Virus mediated gene transfer, Vectorless or direct DNA transfer.</p> <p>UNIT-III DNA SYNTHESIS AND SEQUENCING : Chemical synthesis of gene, Polymerase chain reaction, its variation, application, advantages and limitations, DNA sequencing - Sanger and Coulson method, Maxam Gillbert method, High throughput DNA sequencing, DNA finger printing.</p> <p>UNIT-IV GENOMICS AND PROTEOMICS : Genetic and physical mapping of genes, molecular markers for intregression of useful traits, Transposon mediated gene tagging, genome projects, bioinformatics, functional genomics, microarrays, protein profiling and its significance.</p>
12	MOLECULAR PLANT PATHOLOGY-I	<p>UNIT-I 1. Introduction and history of plant pathology. 2. General Principles of plant pathology and classification of plant diseases. 3. Diseases inciting organisms - Animate Pathogens- fungi, Bacteria, Mycoplasma, Viruses, Nematodes, their general characteristics, heterotrophic behaviour with emphasis on parasitism ability and virulence.</p> <p>UNIT-II 1. Disease Syndrome and General Symptoms of plant diseases : Pathogenic and nonpathogenic; Symptoms caused by fungi, Bacteria, Viruses, Mycoplasma and Nematodes. 2. Sources of Infection : Seeds, soil, water and airborne diseases of plants; Significance of phylosphere and rhizosphere studies. 3. Pathogenesis - Dissemination of plant pathogens; Mode of infection; Inoculum potential.</p> <p>UNIT-III 1. Effect of environment on disease development- Predisposing factors; Survival of fungi; Germination of spores; Disease initiation and Epidemics. 2. Host Parasites relationship - Mechanism and physiology of infection, Path of infection, Role of enzymes, growth regulators and toxins in pathogenesis. 3. Physiological specialization : General account; Physiological specialization with special reference to smuts and rusts.</p> <p>UNIT-IV 1. Recurrence of disease with special reference of recurrence of rust disease in India. 2. Methods of Studying Plant Diseases: General account, Macroscopic study, Microscopic study, Koch postulates, Culture technique, Preparation of culture tubes, media preparation, Inoculation, Isolation, Pure culture, Parasitism of obligate parasites, Methods in bacteriology, Techniques required in introductory bacteriology</p>
13	PLANT REPRODUCTION AND UTILIZATION OF RESOURCES	<p>UNIT-I Reproduction :Vegetative reparation, Methods of propagation. Pollination, Pollinationmechanism and vector, Structure of pistil, Pollen stigma interaction, Sporophytic and gametophytic Self-incompatibility (Cytological, biochemical and molecular aspects), Fertilization, double fertilization, in-vitro fertilization. UNIT-II Male gametophyte : Structure of anther, Microsporogenesis, Role of tapetum, pollen development, male sterility, sperm dimorphism and hybrid seed production, Pollen germination, Pollen tube growth and guidance, Pollen storage, Pollen allergy, Pollen embryo sac. Female gametophyte : Ovule development, Organization of embryo sac and Structure of embryo sac cells. UNIT-III Seed and Fruit development: Endosperm development during early, maturation and desiccation stages. Embryo genesis, Storage proteins of endosperm, Ultra structure and nuclear cytology, Cell lineage during late embryo development, Polyembryony, Apomixes, Embryo culture, Endospermic and non-endospermic seeds, Dynamics of fruit growth, biochemistry and biology of fruit maturation. UNIT-IV Utilization of resources: Plant used as avenue trees for shade,</p>

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		Pollution control and aesthetics, Innovation for meeting world food demands Origin of Agriculture. Green revolution; benefits and adverse consequences. Ethanobotanically important plants of Chhattisgarh. World centers of primary diversity of domesticated plants
14	BIOTECHNOLOGY-II (Plant cell, tissue culture and organ culture)	<p>UNIT-I PLANTS CELLS AND TISSUE CULTURE: General introduction, history, scope, concept of cellular differentiation, cellular totipotency. TISSUE CULTURE MEDIA: Introduction, Media constituents, Media selection, Media preparation. CELL CULTURE: Introduction isolation of single cells. Suspension cultures, Culture of Single cell, Plant cell reactors, Applications of cell culture. CLONAL PROPAGATION - Auxiliary bud proliferation, Meristem and shoot tip culture, bud culture. ORGANOGENESIS AND ADVENTIVE EMBRYOGENESIS : Fundamental aspects of morphogenesis; organogenesis via callus formation, direct adventitious organ formation.</p> <p>UNIT-II SOMATIC EMBRYOGENESIS AND ANDROGENESIS : Mechanisms, techniques and utility. SOMATIC HYBRIDIZATION : Methods of Protoplast isolation, Spontaneous and induced methods of protoplasm fusion, identification and selection of hybrid cells. Regeneration of hybrid plants. Verification and Characterization of somatic hybrids, Cybrids, possibilities, achievements and limitations of protoplast research.</p> <p>UNIT-III CRYOPRESERVATION AND GERMPLASM STORAGE : Raising sterile tissue cultures, Addition of cryoprotectants and pretreatment, freezing, storage, thawing, determination of survival viability. Plant growth and generation, verification, encapsulation and dehydration. Slow growth method, Applications. INTELLECTUAL PROPERTY RIGHTS : Possible ecological risks and ethical concerns.</p> <p>UNIT-IV APPLICATION OF PLANT TISSUE CULTURE : Artificial seeds, Production of hybrids and soma clones. PRODUCTION OF SECONDARY METABOLITES / NATURAL PRODUCTS : Morphological and chemical differentiations, Medium composition for secondary product formation. Growth production patterns, Environmental factors. Selection of cell lines producing high amounts of a useful metabolite, Problems associated with secondary metabolite production Immobilized cellsystem. TRANSGENICS IN CROP IMPROVEMENT: Transgenic for Resistance to biotic and abiotic stresses, Transgenes for quality modification, Terminator seed technology. Chloroplast transformation and its utility</p>
15	ELECTIVE COURSE-- LIMNOLOGY-I	<p>UNIT-1 1.Limnology–Definition, historical development and scope of Limnology. 2.The characteristics of water, Hydrological cycle, Global water balance. 3.Types of fresh water habitats and their ecosystem- (a) Ponds, Streams and rivers. (b) Lakes– General characteristics of lakes and classification of lakes. Definition depth of lakes. Retention and replacement of water in lakes, origin of lakes.</p> <p>UNIT-II 1.Morphometry–Use of various morphometric parameters and Zonation. Food Chains, Food webs, Trophic levels and Energy flow in freshwater ecosystems. Eutrophication: Causes, mechanism and significance, Management of freshwater bodies.</p> <p>UNIT-III Physical Characteristics of Lake water and their role. 1. Light and Temperature- (a) Transmission and absorption of Light, Colour and Transparency of light (b) Distribution of heat in lakes, Temperature Radiation, Stratification and Heat Budget. Comparative analysis of river, reservoir and lakes. 2. Water movements: Flow of water, surface and internal water movements. Turbidity, Salinity and Total Dissolved Solids.</p> <p>UNIT-IV 3. Chemical characteristics of fresh water with special reference to different parameters-Dissolved gases (Oxygen, Carbon di oxide, Hydrogen Sulphide), Seasonal changes in dissolved gases and pH, Hardness, Alkalinity, Sulphates, Nitrogen, Phosphorus, Iron, Sulphur and Silica cycle, Arsenic, and Fluoride</p>
16	LIMNOLOGY-II	<p>UNIT-1 1.Study of Biota (a) Phytoplankton flora-classification of phytoplankton, special distribution of phytoplankton, seasonal distribution and species composition of phytoplankton. Algal blooms effects of salinity and climatic stresses on the distribution of phytoplankton, Phyto-benthos-classification. (b) Phytoplankton and their inter-relationship with Zooplanktons. (c) Aquatic insects, birds and their environmental significance.</p> <p>UNIT-II 1. Lake Flora-Higher Plants. Categories of aquatic higher plants, zonation of rooted higher plants, some peculiarities of aquatic higher plants. 2. Lake Bacteria-occurrence, characteristics and importance. 3.Ecological classification of aquatic higher aquatic plants and their significance. 4. Biotic relationship and interaction among organisms. Symbiosis, competition among algae, Parasitism of algae, predation of algae, impact of human being on algae.</p> <p>UNIT-III 1.Concept of Productivity: Seasonal variation, Primary productivity in freshwater</p>

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		lakes, Estimation of Primary Productivity. 2.Bio indicators-Aquatic flora and fauna in relation to water quality in an aquatic environment. 3. Use and misuse of inland waters. 4. Methods of water quality testing BOD and COD. UNIT-IV 1.Sewage-Definition, composition and its treatment. 2.Pollution by Domestic and Agriculture sewage, Industrial effluent. 3.Causes of pollution of Aquatic Resources, their management and conservation. 4.Resource Conservation-Aquatic pollution, control, legislation, regulation on discharge of industrial effluents and domestic wastes in rivers and reservoirs.
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Course Outcomes of Mathematics Department

S.N.	Name of paper	LEARNING OUTCOME
1	Advanced Abstract Algebra (I)	Unit-I Groups, Unit-II Field theory, Unit-III Perfect fields, Unit-IV Automorphisms of extensions, Unit-V Solution of polynomial equations by radicals
2	Real Analysis	Unit-I Sequences and series of functions, Unit-II Power series, Unit-III Functions of several variables, Unit-IV Jacobians, Unit-V Partitions of unity
3	Topology	Unit-I Countable and uncountable sets., Unit-II Alternate methods of defining a topology in terms of Kuratowski, Unit-III Separation axioms, Unit-IV Compactness, Unit-V Compactness in metric spaces
4	Advanced Complex Analysis (I)	Unit-I Complex integration, Unit-II Maximum modulus principle, Unit-III Residues, Unit-IV Definitions and examples of conformal mapping, Unit-V Spaces of analytic functions
5	Advanced Discrete Mathematics (I)	Unit-I Formal Logic, Unit-II Homomorphism of semigroups and monoids Unit-III Lattices, Unit-IV Direct Products and Homomorphisms, Unit-V Grammars and Languages
6	Advanced Abstract Algebra (II)	Unit-I Modules, Unit-II Linear Transformations -, Unit-III Canonical Forms, Unit-IV Smith normal form, Unit-V Rational canonical form
7	Real Analysis (II)	Unit-I Riemann-Stieltjes integral, Unit-II Lebesgue outer measure, Unit-III Measures and outer measures, Unit-IV The Four derivatives, Unit-V Functions of Bounded variation
8	General and Algebraic Topology	Unit-I Tychonoff product topology, Unit-II Product spaces, Unit-III Embedding and metrization, Unit-IV Nets and filter, Unit-V The fundamental group and covering spaces
9	Advanced Complex Analysis (II)	Unit-I Weierstrass' factorisation theorem, Unit-II Analytic Continuation, Unit-III Harmonic functions on a disk, Unit-IV Canonical products., Unit-V The range of an analytic function
10	Advanced Discrete Mathematics (II)	Unit-I Graph Theory, Unit-II Spanning Trees, Unit-III Directed Graphs, Unit-IV Introductory Computability, Unit-V Finite Automata
11	(Third Semester) PAPER -I Integration Theory and Functional Analysis (I)	Unit-I Signed measure, Unit-II Lebesgue-Stieltjes integral, Unit-III Baire sets, Unit-IV Normed linear spaces, Unit-V Weak convergence and bounded linear transformations
12	(Third Semester) PAPER -II Partial Differential Equations and Mechanics (I)	Unit-I Examples of PDE. Classification, Unit-II Heat Equation, Unit-III Generalized coordinates, Unit-IV Poisson's Bracket, Unit-V Attraction and potential
13	(Third Semester) PAPER-III (C) Fuzzy Set Theory and Its Applications (I)	UNIT-I Fuzzy sets-Basic definitions, UNIT-II The Extension Principle, UNIT-III Fuzzy Relations on Fuzzy sets, UNIT-IV Fuzzy equivalence relations, UNIT-V Possibility Theory
14	(Third Semester) PAPER -IV (A) Operations Research (I)	Unit-I Operations Research and its Scope, Unit-II Other Algorithms for Linear Programmng, Unit-III Parametric Linear Programming, Unit-IV Transportation and Assignment Problems, Unit-V Network Analysis
15	(Third Semester) PAPER-V (B) Graph theory (I)	Unit-I: Operations on graphs, Unit-II: Matrices and vector spaces, Unit-III: Colouring packing and covering, Unit-IV: Combinational formulations, Unit-V: Perfect Graphs
16	Functional Analysis (II)	Unit-I Uniform boundedness theorem, Unit-II Hahn-Banach theorem, Unit-III Inner product spaces., Unit-IV Structure of Hilbert spaces, Unit-V Self-adjoint operators
17	Partial Differential Equations & Mechanics	Unit-I Non-linear First Order PDE-, Unit-II Representation of Solutions, Unit-III Asymptotics, Unit-IV Hamilton's Principle, Unit-V Hamilton-Jacobi equation
18	Fuzzy Set Theory & Its Applications	Unit-I Fuzzy Logic, Unit-II Approximate Reasoning, Unit-III An introduction to Fuzzy Control, Unit-IV Defuzzification and the various defuzzitication methods, Unit-V Decision

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		Making in Fuzzy Environment
19	Operations Research (II)	Unit-I Dynamic Programming, Unit-II Game Theory, Unit-III Integer Programming, Unit-IV Applications to Industrial Problems, Unit-V Nonlinear Programming
20	Graph Theory (II)	Unit-I: Ramsey Theory, Unit-II: Groups Unit-III: Polynomials and Graph Enumeration, Unit-IV: Graph Enumeration, Unit-V: Digraphs & Networks

Course Outcomes of Chemistry Department

S.N.	Name of paper	LEARNING OUTCOME
1	GROUP THEORY AND CHEMISTRY OF METAL COMPLEXES	UNIT - I SYMMETRY AND GROUP THEORY IN CHEMISTRY: Symmetry elements and symmetry operation, definitions of group, subgroup, relation between orders of a finite group and its subgroup. Contumacy relation and classes. Point symmetry group. Schoenflies symbols, representations of groups by matrices (representation for the C_n , C_{nv} , C_{nh} , D_n etc. groups to be worked out explicitly). Character of a representation. The great orthogonality theorem (without proof) and its importance. Character tables of C_{2v} , C_{2h} , C_{3v} and their use in spectroscopy. UNIT - II A. METAL-LIGAND BONDING: Limitation of crystal field theory, molecular orbital theory, octahedral, tetrahedral and square planar complexes. π bonding and molecular orbital theory. B. METAL-COMPLEXES: Metal carbonyls, structure and bonding, vibrational spectra of metal carbonyls for bonding and structural elucidation, important reactions of metal carbonyls; preparation, bonding, structure and important reactions of transition metal nitrosyl, dinitrogen and dioxygen complexes; tertiary phosphine as ligand. UNIT - III A. METAL-LIGAND EQUILIBRIA IN SOLUTION: Stepwise and overall formation constants and their interaction, trends in stepwise constants, factors affecting the stability of metal complexes with reference to the nature of metal ion and ligand, chelate effect and its thermodynamic origin, determination of binary formation constants by pH-metry and spectrophotometry. B. ISOPOLY ACID AND HETEROPOLYACID: Isopoly and heteropoly acids of Mo and W. Preparation, properties and structure. Classification, Preparation, properties and structures of borides, carbides, nitrides and silicides. SILICATES- Classification and structure. SILICONES- preparation, properties and application. UNIT - IV A. METAL CLUSTERS: Higher boranes, carboranes, metallo boranes and metallocarboranes. Metalcarbonyl and halide cluster, compounds with metal-metal multiple bonds. B. CHAINS: Catenation, heterocatenation, intercatenation. C. RINGS: Borazines, phosphazines
2	CONCEPTS IN ORGANIC CHEMISTRY	UNIT - I A. NATURE OF BONDING IN ORGANIC MOLECULES: Localized and delocalized chemical bond, conjugation and cross-conjugation, Bonding in Fullerenes, Bonds weaker than covalent, Addition compounds, Crown ether complexes and cryptands. Inclusion compounds, Cyclodextrins, Catenanes and rotaxanes. B. AROMATICITY: Aromaticity in benzenoid and non-benzenoid compounds, Huckel's rule anti-aromaticity, homo-aromaticity. PMO approach for Aromaticity, Annulenes. UNIT - II A. CONFORMATIONAL ANALYSIS: Conformational analysis of cycloalkanes, decalins, effect of conformation on reactivity, conformation of sugars, steric strain due to unavoidable crowding. B. STEREOCHEMISTRY: Elements of symmetry, chirality, molecules with more than one chiral center, methods of resolution, optical purity, stereospecific and stereoselective synthesis. Asymmetric synthesis. Optical activity in the absence of chiral carbon (Biphenyls, allenes and spiranes), chirality due to helical shape. UNIT - III A. REACTION INTERMEDIATES: Generation, structure, stability and reactivity of carbocations, carbanions, free radicals, carbenes and nitrenes. Sandmeyer reaction, Free radical rearrangement and Hunsdiecker reaction. B. ELIMINATION REACTIONS: The E2, E1 and E1c B mechanisms. Orientation of the double bond. Reactivity, effects of substrate structures, attacking base, the leaving group and the medium. UNIT - IV PERICYCLIC REACTIONS: Classification of pericyclic reactions. Woodward-Hoffmann correlation diagrams. FMO and PMO approach. Electrocyclic reactions - conrotatory and disrotatory motions, $4n$, $4n+2$ and allyl systems. Cycloadditions - antarafacial and suprafacial additions, $4n$ and $4n+2$ system, 2+2 addition of ketenes, 1, 3 dipolar cycloadditions and cheletropic reactions. Sigmatropic rearrangements - suprafacial and antarafacial shifts of H, sigmatropic shifts involving carbon moieties, 3, 3- and 5, 5- sigmatropic rearrangements. Claisen, Cope and Aza-Cope rearrangements. Ene reaction.
	TRANSITION METAL COMPLEXES	SECOND SEMESTER PAPER NO. CH - 7 TRANSITION METAL COMPLEXES Max. Marks 80

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		<p>UNIT - I REACTION MECHANISM OF TRANSITION METAL COMPLEXES: Energy profile of a reaction, reactivity of metal complexes, inert and labile complexes, kinetic application of valence bond and crystal field theories, kinetics of octahedral substitution, anation reactions and reactions without metal ligand bond cleavage. Substitution reactions in square planar complexes, the trans effect. Redox reactions, electron transfer reactions, mechanism of one electron transfer reactions, outer sphere type reactions, cross reactions and Marcus-Hush theory, inner sphere type reactions. UNIT - II ELECTRONIC SPECTRA AND MAGNETIC PROPERTIES OF TRANSITION METAL COMPLEXES: Spectroscopic ground states, Correlation, Orgel and Tanabe-Sugano diagrams for transition metal complexes (d1 - d 9 states), Selection rules, mechanism for breakdown of the selection rules, intensity of absorption, band width, spectra of d-d metal complexes of the type $[M(H_2O)_6]^{n+}$, spin free and spin paired ML₆ complexes of other geometries, Calculations of Dq, B and parameters, spin forbidden transitions, effect of spin-orbit coupling, Spectrochemical and Nephelouxic series. Magnetic properties of complexes of various geometries based on crystal field model, spin free-spin paired equilibria in octahedral stereochemistry. UNIT - III A. TRANSITION METAL COMPLEXES: Transition metal complexes with unsaturated organic molecules, alkanes, allyl, dienedienyl, arene and trienyl complex, preparations, properties, nature of bonding and structure features. Important reaction relating to nucleophilic and electrophilic attack on ligands and organic synthesis. B. Transition Metal, Compounds with Bond to hydrogen. UNIT-IV A. ALKYL AND ARYL OF TRANSITION METALS: Types, routes of synthesis, stability and decomposition pathways, organocopper in organic synthesis. B. COMPOUNDS OF TRANSITION METAL - CARBON MULTIPLE BONDS : Alkylidenes, low valent carbenes, nature of bond and Structural characteristics. C. FLUXIONAL ORGANOMETALLIC COMPOUNDS: Fluxionality and dynamic equilibria in compounds such as olefin, allyl and dienyl complexes.</p>
4	REACTION MECHANISMS	<p>UNIT-I A. ALIPHATIC NUCLEOPHILIC SUBSTITUTION: The S_N2 and S_N1 mechanisms. The neighboring group mechanism, neighboring group participation by π and σ bonds, anchimeric assistance. Reactivity effects of substrate structure, attacking nucleophile, leaving group and reaction medium, phase transfer catalysis, ambident nucleophile and regioselectivity. B. AROMATIC NUCLEOPHILIC SUBSTITUTION: The S_NAr, S_N1 and benzyne mechanisms. Reactivity -effect of substrate structure, leaving group and attacking nucleophile. The von Richter, Sommelet-Hauser, and Smiles rearrangements. UNIT - II A. ALIPHATIC ELECTROPHILIC SUBSTITUTION: Mechanisms of -SE1 SE2, electrophilic substitution accompanied by double bond shifts. Effect of substrates, leaving group and the solvent polarity on the reactivity. B. AROMATIC ELECTROPHILIC SUBSTITUTION: The arenium ion mechanism, orientation and reactivity. The ortho/para ratio, ipso attack, orientation in other ring systems. Reactivity-Effect of substrates and electrophiles. Vilsmeier reaction and Gattermann-Koch reaction. UNIT - III ADDITION TO CARBON-CARBON MULTIPLE BONDS: Mechanistic and stereochemical aspects of addition reactions involving electrophiles, nucleophiles and free radicals, regio and chemoselectivity. Addition to cyclopropane ring. Hydrogenation of double and triple bonds, hydrogenation of aromatic rings Hydroboration, Michael reaction. Sharpless asymmetric epoxidation. UNIT - IV ADDITION TO CARBON-HETERO MULTIPLE BONDS: Mechanism of metal hydride reduction of saturated and unsaturated carbonyl compounds, acids esters and nitriles. Addition of Grignard Reagents, Organo-Zinc and Organo-lithium to carbonyls and unsaturated carbonyl compounds, Wittig reaction. Mechanism of condensation reactions involving enolates-Perkins, Aldol, Claisen, benzoin, Mannich, Knoevenagel, Stobbe reactions. Hydrolysis of esters and amides, ammonolysis of esters.</p>
5	QUANTUM CHEMISTRY, THERMODYNAMICS AND CHEMICAL DYNAMICS – II	<p>QUANTUM CHEMISTRY, THERMODYNAMICS AND CHEMICAL DYNAMICS - II Max. Marks 80 UNIT –I A. APPLICATION OF MATRICES IN QUANTUM CHEMISTRY: Addition and multiplication, inverse and transpose of matrices. Determinants in Quantum Chemistry. B. ANGULAR MOMENTUM IN QUANTUM CHEMISTRY: Angular momentum, angular momentum Operators. Eigen functions and Eigen values Angular momentum, Ladder operators. C. APPROXIMATE METHODS: The variation theorem, linear variation principle. Perturbation theory (first order and non-degenerate). Applications of variation method and perturbation theory to the Helium atom. UNIT –II STATISTICAL THERMODYNAMICS: Probability, permutations and combinations, concepts of probability, Maxwell Boltzmann distribution. Different ensembles and Partition function translational, rotational, vibrational and Electronic partition functions. Thermodynamic function using</p>

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		<p>appropriate Partition function. Fermi-Dirac and Bose-Einstein Statistics and statistical basis of entropy. Heat capacity of solids Debye and Einstein Models. UNIT –III ELECTROCHEMISTRY –II: Structure of electrified interfaces. Gouy-Chapman, Stern models. Over potentials and exchange current density, Derivation of Butler –Volmer equation, Tafel plot. Semiconductor interfaces, Theory of double layer at semiconductor, electrolyte solution interfaces, structure of double layer interfaces. Effect of light at semiconductor solution interfaces. Electro catalysis influence of various parameters. Hydrogen electrode. UNIT –IV CHEMICAL DYNAMICS –II: General features of fast reactions by flow method, relaxation method, flash photolysis and the nuclear magnetic resonance method. Dynamics of molecular motions, probing the transition state, dynamics of barrier less chemical reactions in solutions, dynamics of unimolecular reaction. [Lindemann –Hinshel wood , RRK and RiceRamsperger-Kassel-Marcus {RRKM}] theories of uni mole cular reactions.</p>
6	THEORY AND APPLICATIONS OF SPECTROSCOPY-II	<p>UNIT - I THEORY AND APPLICATIONS OF SPECTROSCOPY –II Max. Marks 80 ULTRAVIOLET AND VISIBLE SPECTROSCOPY: Introduction, Intensity of vibrational – electronic spectra - Frank-Condon principle, dissociation energy, Rotational fine structure of electronic – vibrational transitions, shape of some molecular orbitals viz., H₂, He₂, N₂, O₂. Electronic spectra of organic molecules, chromophores, Applications of electronic spectroscopy and identification of organic molecules. Spectrophotometric studies of complex ions, determination of ligand/metal ratio in a complex, determination of stability constants. UNIT - II INFRA RED SPECTROSCOPY: Introduction, simple and anharmonic oscillators in vibrational spectroscopy, diatomicvibrating rotor, Modes of vibration in polyatomic molecules, vibration-coupling, Fourier Transform IR spectroscopy: instrumentation, interferometric spectrophotometer, sample handling, Factors influencing vibrational frequencies, Application of IR spectroscopy: Interpretation of IR spectra of normal alkanes, aromatic hydrocarbons, alcohols and phenols aldehydes and ketones, ethers, esters, carboxylic acids, amines and amides. UNIT - III MASS SPECTROMETRY: Introduction, basic principles, separation of the ions in the analyzer, resolution, molecular ion peak, mass spectral fragmentation of organic compounds, factors affecting fragmentation, McLafferty rearrangement. Instrumentation, Characteristics of mass spectra of Alkanes, Alkenes, Aromatic hydrocarbons, Alcohols, Amines. Nitrogen rule, ring rule, Molecular weight and formula determination. Gas chromatography-Mass spectrophotometry: Introduction. UNIT - IV NUCLEAR RESONANCE SPECTROPHOTOMETRY: Theory of NMR spectroscopy, interaction of nuclear spin and magnetic moment, chemical shift, precessional motion of nuclear particles in magnetic field, spin-spin splitting, coupling constants, factor affecting the chemical shift, shielding effect, effect of chemical exchange, hydrogen bonding, instrumentation of Fourier transform NMR spectrophotometer, structure determination of organic compounds, Carbon-13 NMR spectroscopy, Multiplicity-proton (1 H) decoupling-noise decoupling, off resonance decoupling, selective proton decoupling. Chemical shift (aliphatic , olephinic, alkyne, aromatic and carbonyl carbon)</p>
7	RESONANCE SPECTROSCOP PHOTOCHEMISTRY Y, AND ORGANOCATALYSIS	<p>UNIT –I A. ELECTRON SPIN RESONANCE SPECTROSCOPY: Hyperfine coupling, spin polarization for atoms and transition metal ions, spin-orbit coupling and significance of g-tensors, application to transition metal complexes (having one unpaired electron). B. NUCLEAR QUADRUPOLE RESONANCE SPECTROSCOPY: Quadrupole nuclei, quadrupole moments, electric field gradient, coupling constant, splittings, applications. UNIT –II A. PHOTOELECTRON SPECTROSCOPY: Basic principle for atoms and molecules; Photoelectric effect, ionization process, Koopman’s theorem, Augerelectron spectroscopy, Determination of Dipole moment. Photoelectron spectra of simple molecules-ESCA. B. PHOTOACOUSTIC SPECTROSCOPY: Basic principle of Photo acoustic Spectroscopy (PAS), PAS –gases and condensed system. Chemical and Surface applications. UNIT –III A. PHOTOCHEMICAL REACTIONS: Interaction of electromagnetic radiation with matter, Stern Volmer equation, types of excitations, fate of excited molecule, quantum yield, transfer of excitation energy, Actinometry. B. DETERMINATION OF REACTION MECHANISM: Classification, rate constants and life times of reactive energy states , determination of rate constants of reactions. Effect of light intensity on the rate of photo chemical reactions. C. MISCELLANEOUS PHOTOCHEMICAL REACTIONS: Photo-Fries reactions of anilides, PhotoFries rearrangement. Barton reaction. Singlet molecular oxygen reactions. Photochemical formation of smog. Photo degradation of polymers, Photochemistry of vision. UNIT –IV A. ORGANOCATALYSIS General Principles: Energetic, Catalytic cycles, catalytic efficiency and life time, selectivity. Type of organometallic</p>

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		reaction: Ligand substitution, Oxidative addition, reductive elimination and insertion and de-insertion. Homogeneous catalysis: Hydrogenation of alkenes, Hydroformylation, Monosubstituted acetic acid synthesis, Wacker oxidation of alkenes. Alkenes metathesis, Palladium-Catalysed C-C bond forming reactions, asymmetric oxidation. Heterogeneous catalysis: The nature of heterogeneous catalysts, Fischer-Tropsch synthesis, alkene polymerization
8	CHEMISTRY OF BIOMOLECULES	<p>UNIT –I Max. Marks 80 A. BIOENERGETICS: Standard free energy change in biochemical reactions, exergonic, endergonic. Hydrolysis of ATP, synthesis of ATP from ADP. B. ELECTRON TRANSFER IN BIOLOGY: Structure and function of metalloproteins in electron transport processes—cytochromes and Iron-sulphur proteins, synthetic models. C. TRANSPORT AND STORAGE OF DIOXYGEN: Heme proteins and oxygen uptake, structure and function of haemoglobin, myoglobin, haemocyanins and haemerythrin, model synthetic complexes of iron, cobalt and copper. UNIT –II A. METALLOENZYMES: Zinc enzymes –carboxypeptidase and carbonic anhydrase. Iron enzymes – catalase, peroxidase and cytochrome P-450. Copper enzymes- superoxide dismutase. Molybdenum oxotransferase enzymes –xanthineoxidase. B. ENZYME MODELS: Host-guest chemistry, chiral recognition and catalysis, molecular recognition, molecular asymmetry and prochirality. Biomimetic chemistry, Cyclodextrin-based enzyme models, calixarenes, ionophores, synthetic enzymes or synzymes. UNIT –III A. ENZYMES: Nomenclature and classification of Enzyme. Induced fit hypothesis, concept and identification of active site by the use of inhibitors. B. CO-ENZYME CHEMISTRY: Structure and biological functions of coenzyme A, thiamine pyrophosphate, pyridoxal phosphate, NAD⁺, NADP⁺, FMN, FAD, lipoic acid, vitamin B12. C. BIOTECHNOLOGICAL APPLICATIONS OF ENZYMES: Techniques and methods of immobilization of enzymes, effect of immobilization on enzyme activity, application of immobilization enzymes in medicine and industry. Enzymes and Recombinant DNA Technology. UNIT –IV A. BIOPOLYMER INTERACTIONS: forces involved in biopolymer interaction. Electrostatic charges and molecular expansion, hydrophobic forces, dispersion force interactions. Multiple equilibria and various types of binding processes in biological systems. Hydrogen ion titration curves. B. THERMODYNAMICS OF BIOPOLYMER SOLUTIONS: Thermodynamics of biopolymer solution, osmotic pressure, membrane equilibrium, muscular contraction and energy generation in mechanochemical system. C. CELL MEMBRANE AND TRANSPORT OF IONS: Structure and functions of cell membrane, ion transport through cell membrane, irreversible thermodynamic treatment of membrane transport and Nerve conduction.</p>
9	CATALYSIS, SOLID STATE AND SURFACE CHEMISTRY	<p>UNIT –I ACIDS, BASES, ELECTROPHILES, NUCLEOPHILES AND CATALYSIS : Acid-base dissociation, Electronic and structural effects, acidity and basicity. Acidity function and their applications. Hard and soft acids and bases. Nucleophilicity scales. Nucleofugacity. The alpha effect. Ambivalent Nucleophilicity. Acid base catalysis-specific and general catalysis. Bronsted catalysis, Enzyme Catalysis. UNIT –II MICELLES AND ADSORPTION : Micelles : Classification of surface active agents, micellization, hydrophobic interaction, critical micellar concentration (CMC), factors affecting the CMC of Surfactants. Thermodynamics of micellization - phase separation and mass action models. Reverse micelles, micro-emulsion. Micellar Catalysis, Surface tension capillary action, pressure difference across curved surface (Laplace equation), vapour pressure of droplets (Kelvin equation), Gibbs adsorption isotherm. UNIT –III SOLID STATE CHEMISTRY - I : Crystal defects and Non-stoichiometry - Perfect and imperfect crystals, intrinsic and extrinsic defects - point defect, line and plane defects, vacancies - Schottky defects and Frenkel defects. Thermodynamics of Schottky and Frenkel defect, formation of color centres, nonstoichiometry and defects. Electronic properties and Band theory of semiconductors. UNIT –IV MACROMOLECULES : Polymer – Definition, types of polymers, electrically conducting, fire resistant, liquid crystal polymers, kinetics of polymerization, mechanism of polymerization. Molecular mass, average molecular mass, molecular mass determination (Osmometry, Viscometry, diffusion and light scattering methods), Sedimentation, chain configuration of macromolecules, calculation of average dimensions of various chain structures.</p>
10	ANALYTICAL TECHNIQUES AND DATA ANALYSIS	<p>UNIT –I SAMPLE PREPARATION, DIGESTION AND STATISTICAL ANALYSIS A. Sampling - Collection, Preservation and preparation of sample, Techniques of sampling solids, liquids and gases, Operation of drying and preparing a solution of the analyte. Principle, methodology and application of different types of digestions such as acid digestion, base digestion, enzymatic and microwave digestion for liquid and solid materials. B. Evolution and procession of Analytical Data, Precision and Accuracy, Types of Errors, Propagation of</p>

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		errors, Normal Distribution Curve, Standard deviation, Confidence limit, Graphical presentation of result-Method of average, Method of Linear least square, Significant figures, Statistical aid to hypothesis testing-t-test, F-test, Correlation coefficient, Rejection of data. UNIT –II SEPARATION TECHNIQUES A. Efficiency of extraction, Selectivity of extraction, Extraction system, Method of Extraction, applications. B. Principle, classification of chromatographic techniques, Technique and applications of paper chromatography, Thin-layer chromatography, HPLC, Column chromatography. Gas Chromatography UNIT –III THERMAL AND AUTOMATED METHODS A. Principle, Instrumentation, Application of TGA, DTA and DSC methods. B. Automated methods, Principle, instrumentation and application off low injection analysis. UNIT –IV ELECTROCHEMISTRY A. Principles and instrumentation of pHpotentiometry, coulometry and conductometry. B. Basic principles, Diffusion current, polarized electrode, Micro electrode, Dropping Mercury Electrode, Ilkovic equation, Polarographic wave, Qualitative analysis Stripping methods, Cyclic Voltammetry, Amperometric titration:- curves, Differential pulse polarography and Squarewave polarography.
11	INSTRUMENTAL METHODS OF ANALYSIS	UNIT –I ADVANCED CHROMATOGRAPHY : A. Ionchromatography: Ion exchange equilibrium, Ion-exchange packing and Inorganic Applications. B. Size exclusion chromatography : Column packing, Theory of size of exclusion chromatography and applications. C. Supercritical fluid chromatography : Properties of supercritical fluid SFC- Instrumentation and operating variables, comparison with other types of chromatography, applications. D. Capillary Electrophoresis and capillary electrochromatography: overviews and applications UNIT –II X-RAY AND PROTON INDUCED SPECTROSCOPY: A. X-Ray fluorescent method: Principles-Characteristics x-ray emission. Instrumentation X-ray tube, radioactive sources. Wave length dispersive instruments. Energydispersive instrumnts. AnalyticalApplications-Qualitative Analysis. B. Proton Induced X-Ray Spectroscopy: Theory, instrumentation and application. UNIT – III ATOMIC EMISSION SPECTROSCOPY A. Selectivity, sensitivity and interferences of atomic spectroscopy. B. Theory, instrumentation and application of flamephotometer, AES, ICP-AES and AFS. UNIT –IV ATOMIC ABSORPTION SPECTROSCOPY AND HYPHENATED TECHNIQUES A. Theory instrumentation and application of flame and graphite furnace AAS, cold-vapour and hydride generation AAS. B. Theory, instrumentation and application of hyphenated techniques i.e. GC/HPLC/-MS, GC/IC/HPLC- ICP-MS.
12	NATURAL PRODUCT AND MEDICINAL CHEMISTRY	A. Terpenoids and Carotenoids: Classification, nomenclature, occurrence, isolation, general methods of structure determination of Citral, Geraniol, α -Terpeneol, Menthol, Farnesol, Zingiberene, Santonin, Phytol, Abietic acid and β –Carotene. B. Alkaloids: Definition, nomenclature and physiological action, occurrence, isolation, general methods of structure elucidation, degradation, classification based on Nitrogen heterocyclic ring, role of alkaloids in plant. Synthesis and biosynthesis of the following: Ephedrine, (+)-Conine, Nicotine, Atropine, Quinine and Morphine. UNIT-II A. Steroids: Isolation, structure determination and synthesis of Cholesterol, Bileacids, And rosterone, Testosterone, Esterone, Progesterone, Aldostrone and Biosynthesis of cholesterol. B. Plant Pigments: Occurrence, nomenclature and general method of structure determination. Isolation and synthesis of Apigenin, Luteolin, Quercetin, Myrcetin, Quercetin-3-glucoside, Vitexin, Diadzine, Butein, Aureusin, Cyanidin, Hirsutidin. UNIT- III A. Drug Design Development of new drugs procedures followed in drug design, concepts of lead compound and lead modification, concepts of prodrugs and soft drugs, Structure-Activity Relationship (SAR), Factors affecting bioactivity, resonance, inductive effect. Theories of drug activity: occupancy theory, rate theory, induced fit theory. Quantitative Structure Activity Relationship(QSAR)-Hansch approach-free Wilson model, relationship between free Wilson and Hans analysis B. Concepts of drug receptors, lipophilicity, phamacophore, pharmacological activity and typical range of parameters related to drug likeness. C. General introduction of pharmacokinetics and pharmaco-dynamics. UNIT – IV A. Antineoplastic Agents: Introduction, Alkylatingagents, antimetabolites, carcinolyticantibiotics, mitoticinhibitors. B. Antibiotics: Constitution and synthesis of penicillins, chloramphenicol, tetracycline and streptomycin. C. Antimalarials: Synthesis and properties of the following Antimalarial drug: 8-amino quinolone derivatives-Pamaquine, Primapune, Pentaquinr, Isopentaquine, 4-aminoquinolonederivatives-Santoquine, Camaquine, Acridine derivatives- Mepracrine, Azacrin, Pyrimidine and Biguanid derivatives-Paludrine Pyremethamine.
13	MATERIAL AND CHEMISTRY NUCLEAR	MATERIAL AND NUCLEARCHEMISTRY Max.Marks 80 UNIT- I NON EQUILIBRIUM

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		<p>THERMODYNAMICS: Fundamental concepts, Forces and Fluxes, Entropy production, Phenomenological Laws and Onsager's theory for biological systems, coupled reactions.</p> <p>UNIT- II MATERIAL CHEMISTRY: Preparation and Properties of Nanoparticles, Materials- Metals, Ceramics (Oxide, carbides, sulphides, nitrides). Physical and Chemical Methods, Size and Shape controlled Synthesis, Sol-gel methods, Optical Properties, Electrical and Magnetic Properties, Application of Nanoparticles. Characterization of Nanoparticles (SEM, TEM etc.)</p> <p>UNIT-III SUPRAMOLECULAR CHEMISTRY: Properties of covalent bonds, bond length, inter bond angles, Force constant, bond and molecular dipole moment, molecular and bond polarizability. Intermolecular Forces, hydrophobic effects, Electro static, induction, dispersion and resonance energy, Hydrogen bond, Magnetic interactions. Principles of molecular association and organization Biological macromolecules, Molecular receptors and design principal, cryptands, Cyclophanes, calixarenes and cyclodextrins. Supramolecular reactivity and catalysis.</p> <p>UNIT-IV NUCLEAR AND RADIOCHEMISTRY NUCLEAR THEORY: Nuclear cross section and nuclear radii, nuclear shells and magic numbers, theory of nuclear shell model, nuclear potentials, square well and simple harmonic oscillator potentials, application, liquid drop model, semi-empirical mass equation, application and limitations. NUCLEAR FISSION: Mass, energy and charge distribution of fission products, decay chains, prompt and delayed neutrons, liquid drop model of nuclear fission. NUCLEAR ENERGY: Nuclear fission, chain reaction, multiplication factor, nuclear reactors APPLIED RADIOCHEMISTRY: Radioactive isotopes, purity and strength of radioisotopes. Radiochemical principle in the use of tracers, Application of Tracers in Chemical investigations, Physico-chemical methods, Analytical applications, Age determinations, Medical applications, Agricultural application.</p>
14	ENVIRONMENTAL & APPLIED CHEMICAL ANALYSIS	<p>ENVIRONMENTAL & APPLIED CHEMICAL ANALYSIS Max. Marks 80 UNIT -I AIR POLLUTION MONITORING AND ANALYSIS Classification of air pollution monitoring levels, air quality, standards and index, monitoring and analysis of selected air borne pollutants: SO₂, NO_x, SPM, Volatile organic compounds, Pb, CO₂, Persistent organic compounds, Hg, carbon and ozone Air pollution control devices Viz ESP, scrubber technique, baghouse filters etc. Atmospheric chemistry of acid rains, photochemical smog, greenhouse effect, global warming, ozone hole.</p> <p>UNIT -II SOIL AND WATER POLLUTION Soil and water quality standards, monitoring and analysis of selected soil and water contaminants: COD, pesticides, heavy metals, POP's, fluoride, cyanide, nitrate, phosphate, oil & grease, Geobiochemical impact of municipal solid waste, steel plants effluent, domestic sewage. Control devices of water pollutants.</p> <p>UNIT -III FOOD ANALYSIS A. Introduction to general Constituents of food, Proximate Constituents and their analysis, Additives- Introduction -Types - Study of preservatives colors and Antioxidants and method of estimation, adulteration - Introduction, Types, Test for adulterants. B. Introduction of standards composition and analysis of following foods: Wheat, Bread, Biscuits, Jam, Jelly, Honey, Milk, Ice Cream, Butter, Cheese, Milk Powder, Oils and Fats, Tea, Coffee, Soft drinks, Alcoholic beverages, Cereal and pulses, Confectionery, Fruits, Vegetables, Egg, Fish, Meat.</p> <p>UNIT -IV COSMETICS, CLINICAL AND DRUG ANALYSIS A. Introduction of Cosmetics, evaluation of cosmetics materials, raw material and additives, Cosmetics colors, Perfumes in cosmetics, Cosmetics formulating, introduction, standards and methods of analysis, Creams, Facepowders, Make-up, Shaving preparations, Bath preparations. B. Concepts and principles of analytical methods commonly used in the clinical species: i.e. ammonia, Nitrogen, Ca, Cl, CO₂, Fe, K, Li, Mg, Na, P, urea, glucose. Method for analysis of proteins (i.e. albumin, bilirubin, creatinine, cholesterol, HDLcholesterol, triglycerides, creatinine) and Enzymes (i.e. Alanine Aminotransferase, acid phosphatase, alkaline phosphatase, amylase, aspartate, aminotransferase, cholinesterase, lactate, and lipase).</p>
15	CHEMISTRY OF SURFACTANTS	<p>UNIT- I OVERVIEW OF SURFACTANTS: Classification of Surfactants, Physicochemical Properties of Surfactants, Critical Micelle Concentration, Determination, Effect of Additives, Aggregate Shapes, Structure and Morphology, Novel and New Generation Surfactants, Aggregation Behavior.</p> <p>UNIT-II PRINCIPLES OF SELF-ASSEMBLY: Closed and Continuous Association, Surfactant Micellization Pseudo-Phase Model, Mass Action Model, Estimation of Micelle Size, Size Dispersion of Micelles, Concentration Dependence of Micelle Size, Phase Behavior, Aggregation Behavior.</p> <p>UNIT-III SURFACTANT MIXTURES: Ideal and Non-Ideal Mixed Micelles, Regular Solution Model Size and Composition Distribution of Aggregates, Nonionic -ionic Surfactant Mixtures, Ionic -Ionic Surfactant Mixtures, Origin of Ideal and Non-Ideal Mixing Behavior, Polymer Surfactant Interaction.</p>

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		UNIT-IV APPLICATIONS OF SURFACTANTS: Micellar Catalysis, Quantitative Models, Micellar Enzymology, Phenomenon of Solubilization , Solubilization in Mixed Micelles, Drug Surfactant Interaction, Protein Surfactant Interactions, Microemulsions and its applications, Industrial Application of Surfactants.
16	NANOCHEMISTRY	<p>UNIT I GENERIC METHODOLOGIES FOR NANOCHEMISTRY AND NANOTECHNOLOGY Introduction and classification, What is nanotechnology?, Classification of nanostructures, Nanoscale architecture, Summary of the electronic properties of atoms and solids, The isolated atom, Bonding between atoms, Giant molecular solids, The free electron model and energy bands, Crystalline solids, Periodicity of crystal lattices, Electronic conduction, Effects of the nanometre length scale, Changes to the system total energy, Changes to the system structure, How nanoscale dimensions affect properties UNIT -II MATERIAL CHEMISTRY Preparation and Properties of Nanoparticles, Materials-Metals, Ceramics (Oxide, carbides, sulphides, nitrides). physical and chemical Methods, Size and Shape controlled Synthesis, Solgel methods, Optical Properteis, Electrical and Magnetic Properties, Application of Nanoparticles. UNIT-III CHARACTERIZATION METHODS X-ray diffraction, Debye-Scherer formula, dislocation density, micro strain, Synchrotron Radiation, Principle and Applications, Raman Spectroscopy and its Applications, Dynamic Light Scattering (DLS). Electron microscopes: scanning electron microscope (SEM), transmission electron microscope (TEM), atomic force microscope (AFM), scanning tunneling microscope (STM), XPS, Working Principle, Instrumentation and Applications. Differential scanning calorimeter (DSC), Thermogravimetric/Differential Thermal Analyzer (TG/DTA), UV – Visible Spectrophotometer, FTIR, Principle and Applications, Photoluminescence (PL) Spectroscopy. UNIT-IV APPLICATIONS ON NANOCHEMISTRY Nanobiology, Introduction, Bio-inspired nanomaterials, Interaction between Biomolecules and Nanoparticle Surfaces, Different Types of Inorganic Materials used for the Synthesis of Hybrid Nano-bio Assemblies, Applications of Nano in Biology, Nanoprobes for Analytical Applications, Current Status of Nanobiotechnology, Future Perspectives of Nanobiology; Nanosensors, Electrochemical, Nanobiosensors, Smart Dust; Nanomedicines, Nanodrug Administration Diagnostic and Then rapeutic Applications. BOOKS SUGGESTED : 1. Nanoparticles: From Theory to Application</p>
17	POLYMERS	<p>UNIT-I I Basics 8Hrs Importance of polymers. Basic concepts: Monomers, repeat units, degree of polymerization. Linear, branched and network polymers. Classification of polymers. Polymerization: condensation, addition, radical chain-ionic and co-ordination and co-polymerization. Polymerization conditions and polymer II reactions. Polymerization in homogeneous and heterogeneous system. Polymer Characterization 14Hrs Polydispersion-average molecular weight concept. Number, weight and viscosity average molecular weights. Polydispersity and molecular weight distribution. The practical significance of molecular weight. Measurement of molecular weights. End-group, viscosity, light scattering, osmotic and ultracentrifugation methods. Analysis and testing of polymers-chemical analysis of polymers, spectroscopic methods, X-ray diffraction study. Microscopy. Thermal analysis and physical testing-tensile strength. Fatigue, impact. Tear resistance. Hardness and abrasion resistance. UNIT-II III Structure and Properties 14Hrs Morphology and order in crystalline polymers-configurations of polymer chains. Crystal structure of polymers. Morphology of crystalline polymers, strain-induced morphology, crystallization and melting. Polymer structure and physical properties-crystalline melting point T_m- melting point of homogeneous series, effect of chain flexibility and other steric factors, entropy and heat of fusion. The glass transition temperature, T_g-Relationship between T_m and T_g, effects of molecular weight, diluents, chemical structure, chain topology, branching and cross linking. Property requirements and polymer utilization. UNIT-III IV Polymer Processing 12Hrs Plastics, elastomers and fibres. Compounding. Processing techniques: Calendering, die casting, rotational casting, film casting, injection moulding, extrusion moulding, thermoforming, foaming, reinforcing and fibre spinning. UNIT-IV V Properties of Commercial Polymers 12Hrs Polyethylene, polyvinyl chloride, polyamides, polyesters, phenolic resins, epoxy resions and silicone polymers. Functional polymers- Fire retarding polymers and electrically conducting polymers. Biomedical polymers-contactlens, dental polymers, artificial heart, kidney, skin and blood cells.</p>

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Course Outcomes of Zoology Department

S.N.	Name of paper	LEARNING OUTCOME
1	M. Sc. ZOOLOGY FIRST SEMESTER PAPER – I BIOSYSTEMATICS, TAXONOMY AND BIODIVERSITY	<p>UNIT-I • Definition and basic concepts of biosystematics and taxonomy. • Historical resume of systematics. • Importance and applications of biosystematics in biology • Trends in biosystematics concepts of different conventional and newer aspects • Chemotaxonomy • Cytotaxonomy • Molecular taxonomy</p> <p>UNIT-II • Dimensions of speciation and taxonomic characters • Mechanisms of speciation in panmictic and apomictic species • Species concepts and species category. • Theories of biological classification. • Taxonomic characters and different kinds.</p> <p>UNIT-III • Procedure keys in taxonomy. • Taxonomic procedures-taxonomic collections, preservation, curation • Taxonomic keys-different kinds of taxonomic keys, their merits and demerits. • Process of typification and different Zoological types. • International code of Zoological Nomenclature (ICZN) •</p> <p>UNIT-IV • Biodiversity • Types of Biodiversity • Hot spots of Biodiversity • Threats to Biodiversity • Conservation of Biodiversity • Evaluation of biodiversity indices • Shannon-Weiner index.</p>
2	M.Sc. ZOOLOGY FIRST SEMESTER PAPER-II: STRUCTURE & FUNCTION OF INVERTEBRATES	<p>UNIT-I • Organization of coelom • Acoelomates and Pseudocoelomates • Coelomates: Protostomia and Deuterostomia. • Locomotion • Flagellar and ciliary movement in Protozoa. • Hydrostatic movement in Coelenterata, Annelida and Echinodermata. UNIT-II • Nutrition and Digestion • Patterns of feeding and digestion in Protozoa • Filter feeding in polychaeta. • Respiration • Organs of respiration Gills, lungs and trachea. • Respiratory pigments. UNIT-III • Excretion • Organs of excretion. • Excretion and osmoregulation • Nervous System • Primitive nervous system: Coelenterata and Echinodermata. • Advanced Nervous system: Annelida, Arthropoda (Crustacea and insecta) and Mollusca (Cephalopoda) • UNIT-IV • Invertebrate larvae • Larval forms of free-living and parasitic invertebrates • Minor Phyla • Organization and general characters of (Ctenophore, Rotifera, Ectoprocta, Endoprocta)</p>
3	M. Sc. ZOOLOGY FIRST SEMESTER PAPER-III: POPULATION GENETICS & EVOLUTION	<p>UNIT-I • Concepts of evolution and theories of organic evolution: Lamarckism, Darwinism and Synthetic theory of evolution • Evidences of evolution: anatomical, embryological, palaeontological, physiological and Bio-chemical</p> <p>Unit-II • Hardy-Weinberg law of genetic equilibrium • Detailed account of destabilizing forces. • Natural selection • Mutation • Genetic drift • Meiotic drive • Phenotypic variation</p> <p>UNIT-III • Patterns and mechanisms of reproductive isolation • Phylogenetic and biological concepts of species • Gene Evolution, Evolution of gene families • Factors affecting human disease frequency</p> <p>UNIT-IV • Origin of higher categories • Micro-and Macro-evolution • Evolution of horse, elephant, camel, man</p>
4	M. Sc. ZOOLOGY FIRST SEMESTER PAPER-IV: TOOLS & TECHNIQUES IN BIOLOGY	<p>UNIT-I • Principles and application of • Ultracentrifugation • Electrophoresis • Chromatography (various types) • Lambert-Beers Law and colorimetry and spectrophotometry • Flow cytometry.</p> <p>UNIT-II • Principles and Application of • Light Microscopy and micrometry • Phase Contrast microscopy • Interference microscopy • Fluorescence microscopy • Transmission Electron microscopy. • Scanning Electron microscopy.</p> <p>UNIT-III • Assay • Chemical assays • Biological assays-in vivo and invitro • Principles of cytological and cytochemical techniques • Fixation: chemical basis of fixation by formaldehyde, glutaraldehyde, chromium salts, mercury salts, osmium salts, alcohol and acetone • Chemical basis of staining of carbohydrate, protein lipids and nucleic acids.</p> <p>UNIT-IV • Principle and techniques of • Nucleic acid hybridization and dot curve • Sequencing of proteins and nucleic acids • Freeze techniques • Media preparation and sterilization • Inoculation and growth monitoring</p>
5	M. Sc. ZOOLOGY SECOND SEMESTER PAPER – I: MOLECULAR CELL BIOLOGY AND BIOTECHNOLOGY	<p>UNIT-I • Biomembranes • Molecular composition and arrangement Transport across membrane • Structure and function Mitochondria • Golgi complex Lysosome Ribosome</p> <p>UNIT-II • DNA replication • Transcription • Translation • Genetic code • Mechanisms of initiation, elongation and termination • Regulation of translation</p> <p>UNIT-III • Genome organization • Chromosomal organization: morphological and structural types. • Non-coding DNA • Molecular mapping of genome • Genetic and physical maps • Polymerase Chain Reaction (PCR) and blotting techniques • Molecular</p>

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		<p>markers in genome analysis.</p> <p>UNIT-IV • Transgenic animals and knock-outs • Production and applications • Embryonic stem cells • Application of genetic engineering • Medicine • Agriculture • Industry</p>
6	M. Sc. ZOOLOGY SEMESTER - II PAPER – II: GENERAL PHYSIOLOGY AND ENDOCRINOLOGY	<p>UNIT-I • Digestion and Metabolism • General organization of alimentary canal • Mechanism of digestion • Mechanism of absorption • Gas Exchange and Acid-base Balance • Oxygen and Carbon dioxide transport in blood • The role of hemoglobin • Regulation of body pH</p> <p>UNIT-II • Muscle Function and Movement • Anatomy of muscle • Mechanism of muscle contraction • Regulation of muscle contraction • Nervous System • Neurons and membrane excitation • Action potentials • Synapses and neurotransmitters UNIT III • Sensory Transduction • Auditory receptors • Chemoreceptor: taste and smell • Vision and Photoreception – Photo Chemistry of vision • Thermoregulation and Cold Tolerance • Heat balance and exchange • Endotherms Vs Ectotherms • Torpor, hibernation and aestivation</p> <p>UNIT-IV • Endocrinology • Structure and functions of endocrine glands (Pituitary, pineal, pancreas, adrenal, thyroid etc.) • Ghrelin, Amglin, Leptin, Orsxin • Biosynthesis of hormones (thyroid and gonadal) • Hormones and Reproduction -Pregnancy, Parturition, Lactation • Oeshans menstrual cycle Menarche Menopause</p>
7	M. Sc. ZOOLOGY SEMESTER - II PAPER – III: DEVELOPMENT BIOLOGY	<p>UNIT-I • Oogenesis • Differentiation and growth of oocytes. • Organization of egg cytoplasm and egg cortex. • Vitellogenesis • Spermatogenesis • Differentiation and ultra-structure of sperm • Spermato cytogenesis Spermiation</p> <p>UNIT-II • Fertilization • Biological role of fertilization. • Basic requirements of fertilization. • Activation of egg metabolism • Capacitation • Biochemistry of fertilization • Cleavage • Characteristics and mechanisms of cleavages, Egg types UNIT-III • Formative movements • Fate maps • Utility and comparative topographical relationship of the Presumptive areas in early embryos of • Amphioxus • Fishes • Amphibian • Birds • Differentiation</p> <p>UNIT-IV • Cell and tissue interactions in development • Primary embryo induction • Competence • Concept of organizer • Metamorphosis • Teratology</p>
8	M. Sc. ZOOLOGY SEMESTER - II PAPER – IV: QUANTITATIVE BIOLOGY AND COMPUTER APPLICATION	<p>UNIT-I • Introduction to digital computer and application • Basic knowledge of hardware and software • CPU (Central Processing Unit) • Input and Output devices • Auxiliary storage system • Operating system and Binary number system</p> <p>UNIT-II • Computer application • Introduction to MS office • Word • Excel • Power point • Computer application in biostatistics • Simple computation and elementary knowledge of flow chart</p> <p>UNIT-III • Types of biological data • Representation of data • Sample and sampling • Measures of central tendency • Measures of dispersion • Hypothesis testing: Null and alternate hypothesis UNIT-IV • Tests of significance • Chi-square test • Student's t-test • Analysis of Variance • Simple linear regression • Correlation • Probability distribution: normal and binomial</p>
9	M. Sc. ZOOLOGY SEMESTER - III PAPER-I: COMPARATIVE ANATOMY OF VERTEBRATES	<p>UNIT-I • Origin of Chordates • Amphibians, Reptiles, Birds and Mammals. • Classification of Vertebrates and specialty of respective classes • Amphibians, Gymnophiona Neoteny, Parental case • Reptiles – Extinct reptiles • Birds – Palate in Birds • Mammals. – New world and old world Mankeys</p> <p>UNIT-II • Vertebrate integument and its derivatives. • General structure and functions of Integument. • Structure and functions of glands, scales, horns, claws, nails, hoof, feather and hair. • Skeletal system in vertebrates. • Comparative account of (i) Jaw suspensorium, (ii) Limbs and Girdles.</p> <p>UNIT-III • Respiration in Vertebrates. • Comparative account of respiratory organs (structure and functions). • Circulation in Vertebrates. • Structure and function of blood. • Evolution of heart. • Evolution of aortic arches.</p> <p>UNIT-IV • Nervous System – Central, Peripheral and Autonomic. • Sense organs. • Comparative account of Sensory Receptors. • Evolution of Urinogenital system in vertebrates.</p>
10	M. Sc. ZOOLOGY SEMESTER – III PAPER-II: ANIMAL BEHAVIOUR	<p>UNIT- I • Historical perspectives- Ethology • Behavioural patterns • Innate behaviour • Biological rhythms • Types of biological rhythm • Biological clock</p> <p>UNIT- II • Communications • Auditory • Visual • Chemical • Learning and Memory • Conditioning • Habituation • Reasoning • Reproductive behavior.</p> <p>UNIT-III • Orientation • Echolocation in bats • Bird migration and navigation. • Fish</p>

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		<p>migration. • Neural and hormonal control of behaviour</p> <p>UNIT-IV • Hormonal effect on behavioural patterns. • Social behaviour • Social organization in insects and primates • Schooling in fishes and Flocking in birds • Homing, territoriality, dispersal • Altruism • Host-parasite relation</p>
11	M. Sc. ZOOLOGY SEMESTER – III PAPER – III: ENVIRONMENT PHYSIOLOGY AND POPULATION ECOLOGY	<p>UNIT – I Population dynamics: • Demography, life table, reproductive rates, reproductive values • Population growth, exponential, non overlapping • Stochastic and time lag models of population growth • Population density • Population evolution • Community dynamics: Characteristics, development and classification</p> <p>UNIT-II • Adaptations • Levels of adaptation. • Mechanisms of adaptation. • Adaptation to different environments. • Marine, shores and estuaries. • Freshwater. • Terrestrial Life.</p> <p>UNIT-III • Stress Physiology • Basic concepts of environmental stress and strain, Concept of elastic and plastic strain. • Stress avoidance, stress tolerance and stress resistance. • Acclimatization, acclimation and adaptation. • Endothermic and physiological mechanism of regulation of body temperature.</p> <p>UNIT -IV • Stress physiology in different conditions • Osmoregulation in aqueous and terrestrial habitats. • Physiological response to oxygen deficient stress. • Physiological response to body exercise. • Effect of meditation and yoga</p>
12	M. Sc. ZOOLOGY SEMESTER – III PAPER – IV: IMMUNOLOGY AND PARASITISM	<p>UNIT-I • Cells of immune system • B-Lymphocytes, T-lymphocytes (N K Cells, Helpa Cells, Killer Cells) • Mononuclear cells • Granulocytic cells (Neutrophils, Eosinophils and Basophils) • Mast cells • Dendritic cells • Organs of immune system • Primary lymphoid organs (Thymus, bone marrow) • Secondary lymphoid organs (Lymph nodes, spleen, mucosal associated lymphoid tissue, cutaneous associated lymphoid tissue)</p> <p>UNIT-II • Immunoglobulin structure and function • Molecular structure of Ig, Light chain and Heavy chain • Immunoglobulin classes • IgG • IgM • IgE • IgD Monoclonal antibodies</p> <p>UNIT-III • Antigens Immunogenicity • Contribution of the immunogens. • Contribution of Biological system. • Antigen - Antibody Interaction • Antibody affinity and activity • Cross reactivity • Agglutination reactions • Precipitation Reaction • Vaccine • Active and passive immunization • Whole organism vaccine • Recombinant vector vaccines • DNA vaccines</p> <p>UNIT-IV • Immune system in Health disease • Immune response to infectious disease • Immune response in cancer • Pathophysiology of parasitic infection • Viral infections • Bacterial infection • Helminth infection • AIDS</p>
13	M. Sc. ZOOLOGY SEMESTER – IV PAPER – I (Compulsory) BIOCHEMISTRY	<p>UNIT-I • Properties of Proteins • Structure and properties of amino acids. • Classification of proteins. • Structure of proteins. • Biological Functions of Proteins. • Protein Metabolism.</p> <p>UNIT-II • Carbohydrates • Classification of carbohydrates. • Structure and Functions of Carbohydrates. • Carbohydrate metabolism. • Lipid • Lipid structure and functions • Lipid metabolism.</p> <p>UNIT-III • Vitamins • Water and Fat soluble vitamins, • Chemistry, occurrence and physiological role. • Enzymes • Classification and nomenclature. • Mechanism of action • Regulation of enzyme activity and functions of Co-enzymes. UNIT-IV • Nucleic acid • Chemistry of DNA. • Chemistry of RNA. • Biological importance of nucleic acids. • Nucleoproteins. • Metabolism of nucleic acids.</p>
14	M. Sc. ZOOLOGY SEMESTER – IV PAPER II (Compulsory) NEUROPHYSIOLOGY	<p>UNIT - I • Physiological role of neurosecretory cells • Histological structure of neurons and neuroglial cells • Physiological properties of neural fibres • Synapsis and synaptical transmission • Myoneural junction and neuromuscular transmission • Degeneration and regeneration of nerve fibre</p> <p>UNIT - II • Nerve fibre, peripheral nerves, receptors and effector endings, dermatomes and muscle activity • The spinal cord and the ascending and descending tracts • The cranial and spinal nerves</p> <p>UNIT - III • The fore brain, brain stem, the cerebellum • The meninges and cerebrospinal fluid • Peripheral nervous system</p> <p>UNIT - IV • Autonomic nervous system; sympathetic and para-sympathetic nervous system with special comparison to hormonal mechanism of transmission through autonomic nervous system • Reflex action; varieties, characteristics, unconditional reflex, electrophysiology of spinal reflexes • Sensation • Electro encephalography and its physiological basis</p>
15	M. Sc Zoology Semester-IV Paper- III A (optional paper)	<p>Ichthyology (Fish) Structure and Function Unit-1 • Origin and evolution of fishes • Classification of fishes as proposed by Berg • Fish integument • Locomotion • Alimentary</p>

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		<p>canal and digestion Unit-2 • Accessory respiratoryorgans • Air bladder and itsfunctions • Weberian ossiclestheir homologies and functions • Excretion and osmoregulation • Acoustico-lateral linesystem Unit-3 • Luminous organs • Colouration infishes • Sound producing organs • Deep sea adaptions • Hill streamadaptions Unit-4 • migration in fishes • Sexual cycle and fecundity • parental care infishes • Early development and hatching • Poisonous and venomousfishes.</p>
16	M.Sc Zoology Semester-IV Paper- III B (Optional) Cell Biology	<p>Unit-1 • Molecular organization of eukaryotic chromosomes : structure of nucleosome particles and higher order compectionof mitotic chromosomes, chromatinremodeling • specialized chromosomes:structural organization and functional significance of polytenechromosomes • DNA methylation and DNA Aase-1 Hypersensitivity in relation to gene activity and chromatin organization. • specialized chromosomes II: structural organization and functional significance of lamprbrush chromosome. • Organisation and significance of heterochromatin. Unit-2 • Structural organization of Eukaryotic genes, interrupted genes and overlapping genes and their evolution • Gene families: organization, evolution and significance • Transposable genetic elements of prokaryotes and eukaryotes Gene imitation and molecular mechanism of occurrence of mutation repair mechanism • Organisation of eukaryotic transcriptional machinery promoter enhancers transcription factors polymerase activators and repressors. • DNA binding domains of transcription apparatus zinc finger steroid receptors hemeo domains HILIX-loop, Helix and Leucine Zipper.</p> <p>Unit-3 • Eukaryotic transcription of Eukaryotic transcriptional control. • Environmental modulation of gene activity (stress response)stress genes and stress proteins • Molecular basis of thalasemias muscular dystrophy cystic fibrosis • DN Arearrangement • Amplification during development with special response to • Ciliates • Chlorine gene • 58 RNA genes</p> <p>Unit-4 • Drosophiladevelopment • Cleavage • Grastrulation • Origin of Anterior – Posterior (Maternal effect genes ans segmentation genes • Drosophila development II origin of dordal ventral polarity • Basic idea of homoetic selector genes and homeotic mutation • Basic idea of organization ofhomeo boxes • Evolutionary significance of homeoboxes</p>
17	M.Sc. Zoology Semester-IV Paper- III C (Optional) Entomology	<p>Unit-1 • Insect head types and modification as per their habit and habitat • Modification of mouth parts and feeding behaviour • Structure types and function of antennae • Hypothetical wingvenation • Structure of cuticle and pigment</p> <p>Unit-2 • Sclerotisation and tanning of the cuticle • Structure of alimentary canal and Physiology of digestion • Malphighian tubules – anatomical organization , Transport mechanism • Structure of circulatory system • Cellular elementsin the haemolymph</p> <p>Unit-3 • Cell mediated and humoral immunity • Structure of compound eye and Physiology of Vision • Sound Production ininsect • Structure and function of endocrine glands • Pheromones</p> <p>Unit-4 • Embryonic membranous up to the formation of blastoderm • Metamorphosis • Insecticide effects onCNS • Important pest of Soybean Modern concept of pestmanagement Suggested Reading Materials:</p> <p>• The Insect: Structure and function byR.F. Chapman • Comparative Insect physiology, Biochemistry and Pharmacology .Vol :1-13. Edited by G.A. Kerkut and L.I.Gilbert. • Entomophagous Insect byClausen • Entomology buGilbert • Principles of Insect Physiology by Wigglesworth. • Fundamentals of Entomology byElzinga • Hand book of economic Entomology for South India by Ayyar. • Insect cytogenetics byR.E.F.Symposium. • Insects and plants by Sting, Lawton andsouthwood. • Insect and hygiene byBusvine. • Insect Physiology by Wigglesworth. • Insect morphology by Mat Calf and Flint • Applied Agricultural Entomology by Dr. Lalit Kumarjh</p>
18	M.Sc Zoology Semester-IV Paper- III D (Optional) Wild Life Conservation	<p>Unit-1 • Wild life - • Values of wild life - positive and negative. • Our conservationethics. • Importance of conservation. • Causes of depletion. • World conservationstrategies. • Habitat analysis, Evaluation and management of wild life. • Physical parameters - Topography, Geology, Soil and water. • Biological Parameters - food, cover, forage, browse and cover estimation. • Standard evaluation procedures - remote sensing and GIS. •</p>

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		<p>Management of habitats- • Setting back succession. • Grazing logging. • Mechanical treatment. • Advancing the successional process. • Cover construction. • Preservation of general genetic diversity. Unit-2 • Population estimation. • Population density, Natality, Birth rate, Mortality, fertility schedules and sex ratio • computation. • Faecal analysis of ungulates and carnivores - Faecal samples, slide preparation, Hair identification, Pug marks and census method. • National Organization. • Indian board of wild life. • Bombay Natural History Society. • Voluntary organization involved in wild life conservation. • Wild life Legislation - Wild Protection act - 1972, its amendments and implementation. • Management planning of wild life in protected areas. • Estimation of carrying capacity Unit-3 • Eco tourism / wild life tourism in forests. • Concept of climate persistence. • Ecology of perturbation. • Management of excess population & translocation. • Bio-telemetry. • Care of injured and diseased animal. Unit-4 • Quarantine. • Common diseases of wild animal. • Protected areas National parks & sanctuaries, Community reserve. • Important features of protected areas in India. • Tiger conservation - Tiger reserve in M.P, in India. • Management challenges in Tiger reserve</p>
19	M. Sc Zoology Semester-IV Paper- III E (Optional)	<p>Biology of vertebrate immune system Unit-1 • Tissues of Immune system- Primary lymphoid organs, structure and functions • (Thymus and Bursa of Fabricius) • tissues of Immune system- Secondary lymphoid organs, structure and functions • (Spleen, lymph node and Peyer's patches) • Antigen processing • Antigen presentation Unit-2 • T-cell lineage and receptors • T-cell activation • B-cell lineage and receptors • B-cell activation • Immunoglobulin structure, Biological and physical properties of immunoglobulin • Gene model for Immunoglobulin gene structure Unit-3 • Generation of antibody diversity (Light and heavy chain) • Immunization • Immediate type of hypersensitivity reaction of Anaphylactic type-1. • Antibody dependent cytotoxic type II reaction. • Complex mediated type III reaction Unit-4 • Delayed type cell mediated hypersensitivity type IV reaction. • Enzyme linked immunosorbent assay (ELISA) technique and its applications. • Immunofluorescence technique (Direct & Indirect and Sandwich antibody labelling techniques. • Immunodiffusion techniques (Mancini and Ouchterlony immunodiffusion techniques) Monoclonal antibody technology (Hybridoma technology) M</p>
20	M.Sc Zoology Semester-IV Paper- IV B (Optional) Cellular Organization and Molecular Organization.	<p>Unit-1 • General organization and characteristics of viruses (Examples SV 40 and HIV). • Yeast : Structure, reproduction and chromosome organization: Basic ideas of its applications as vectors for gene cloning. • Molecular organization of respiratory chain assemblies, ATP / ADP • Translocase and F₀F₁ ATPase. • Cell cycle: Cell cycle control in mammalian cells and xenopus. • Cytochemistry of Golgi complex and its role in cell secretion., Unit-2 • Peroxisomes and tripartite proteins. • Nucleolus: Structure and Biogenesis and functions of lysosomes. • Intracellular digestion : Ultra structure and function of lysosomes. • Synthesis and targeting of mitochondrial proteins. • Secretory pathways and translocation of secretory proteins across the ER membrane. Unit-3 • Genome complexity: C- value [paradox and cot value]. • DNA sequences of different complexity. • Difference between normal cells and cancer cells. • Biochemical changes. • Cytoskeleton changes. • Cell surface changes. • Genetic basis of human cancer Unit-4 • Chromosomal abnormalities in human cancer. • General idea of oncogenes and proto oncogenes. • Oncogenesis and cancer. • Transforming Agents. • Tumor suppressor genes. • Receptor – Ligand interaction and signal transduction. Cross – talk among various signaling pathways.</p>

Course outcome of PGDCA

S.N.	NAME OF PAPER	COURSE OUTCOME
1	PGDCA-101	INTRODUCTION TO SOFTWARE ORGANIZATION
2	PGDCA-102	PROGRAMMING IN C
3	PGDCA-103	OFFICE AUTOMATION AND TALLY
4	PGDCA-104	PRACTICE BASED ON PGDCA-101

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5	PGDCA-105	PRACTICLE BASED ON PGDCA-102
6	PGDCA-106	GUI PROGRAMMING IN VISUAL BASIC
7	PGDCA-107	DATABASE MANAGEMENT SYSTEM
8	PGDCA-108	ESSENTIALS IN E-COMMERCE AND HTML
9	PGDCA-109	PRACTICLE BASED ON PGDCA-106, 107, 108
10	PGDCA-110	PRACTICLE BASED ON PGDCA-109, 110