SYLLABUS

RAMANUJAN SCHOOL OF SCIENCE

BACHLOR OF SCIENCE

(Microbiology)

(B. Sc. (Microbiology) – CKUG04C03)

(Effective from Academic Year 2023-24)

2023-24

AN ISO 9001:2015 CERTIFIED FOR QMS
DR. C.V. RAMAN UNIVERSITY
Madhya Pradesh, Khandwa AN AISECT GROUP UNIVERSITY
Approved by : MP. Govt., AICTE, NCTE, MP PARAMEDICAL COUNCIL, PCI Recognized by : UGC Member of : AIU

CVRU
विद्या परं देवता
DR. C.V.RAMAN UNIVERSITY

Preamble

The objective of any program at Higher Education Institute (HEI) is to prepare future professionals well equipped with attitude – skills and knowledge demanded by the growing society. The CVRUK envisions all its programs in the best interest of its students and in this endeavor, it offers a new vision to all its under graduate courses. It imbibes Learning Outcome - Based Curriculum Framework (LOCF) for all its under graduate programs. The LOCF approach is envisioned to provide focused, outcome – based syllabus at the undergraduate level with an agenda to structure the teaching – learning experiences in a more student - centric manner.

The LOCF approach has been adopted to strengthen students' experience as they engage themselves in the program of their choice. The under graduate programs will prepare the students both for academic pursuit as well as enhance her / his employability.

Each program vividly elaborates its nature and promises the outcomes that are to be accomplished by studying the courses. The programs also state the attributes that it offers to inculcate at the graduation level. The graduate attributes encompass values related to well-being, emotional stability, critical thinking, social justice also skills for employability. In short, each program prepares students for sustainability and life-long learning.

The new curriculum of B.Sc. Microbiology offers the students to gain the requisite knowledge, skills, and aptitude for the field of life science. The efforts are made to measure cognitive as well as applied learning. Students are not only trained on the core components but also in areas which are need based, innovative, and relevant keeping in pace with the fast-growing industry. The course is internationally competitive.

The CVRUK hopes the LOCF approach of the program B.Sc. Microbiology will help students in making an informed decision regarding the goals that they wish to pursue in further education and life, at large.

1. Introduction to B.Sc. Microbiology

The B.Sc. Microbiology course at the bachelor's level is being offered at CVRUK in its 3rd year of operation and introduced by setting up / or continuing at S. Ramanujan school of science from the academic year 2023 - 24. The course is being prepared keeping in view, the unique requirements of region, GOI' new policy initiatives like "One District One Commodity" or start – up policy / skill enhancement policy / new education policy. The policies of GOI and Go MP enshrine the spirit of dealing with the job creation and rapid growth in economy, ceasing the opportunity of setting up of new industries in the region. This necessitates the need of technically trained, educated human resources having knowledge, skills, and attitude to deal with the emergent needs of the "New Sun Shine" industry. The graduate level degree of B.Sc. Microbiology would help develop a cadre of professionals to provide necessary human resource.

The B.Sc. Microbiology course in Choice Based Credit System is of 3 - year duration which comprises of 6 semesters, divided into 11 Core papers, 4 ability enhancement course (AEC),4 Skill Enhancement Elective Courses (SEC) and 3 Inter discipline course (IDC)Courses and 2 Value added courses (VAC). Each year consists of 2 semesters. This course has been prepared keeping in view, the unique requirements of B.Sc. Microbiology students.

The objectives of the program are:

- To acquaint the students with policy domain and related legislations applicable in setting the research and value addition industry;
- To impart knowledge in areas related to Microbiology
- To enable the students to understand the composition and physiology of microbial communities in the environment such as bioreactor aspects.
- To acquaint the students with the biotechnological application of microorganism to solve environmental problem.
- To stress on the importance of principle of bioinstrumentation and techniques and quality management, national and international levels and standards, and regulations as well as importance of industrial and agriculture microbiology.

The course contents have been so designed that it can keep pace with the rapidly growing microbial industry. Since, Microbiology is an interdisciplinary science it is recommended that subjects like biology, chemistry, biochemistry, botany, agriculture microbiology medical microbiology, biotechnology etc be preferably chosen as the inter discipline course (IDC)

by the students as they are synergistic to the curriculum. However, students are free to pick up any of the inter discipline course offered by other departments.

2. Learning Outcome Based Curriculum Framework

2.1 Nature and Extent of the Program in B.Sc. Microbiology.

The learning outcomes-based curriculum framework is based on the premise that every student and graduate is unique. Each student or graduate has his/her own characteristics in terms of previous learning levels and experiences, life experiences, learning styles and approaches to future career related actions. The quality, depth and breadth of the learning experiences made available to the students while at the higher education institutions help develop their characteristic attributes.

2.2 Aims of Bachelor Degree Program in B.Sc. Microbiology

The key objectives that underpin curriculum planning and development at the undergraduate level include Program Learning Outcomes, and Course Learning Outcomes. For the B.Sc. Microbiology course, it includes:

- To make students and aspirants aware of the policy domain and related legislations in the upcoming microbial research industry not only in regional or national perspective but global perspective as well;
- To demonstrate comprehensive knowledge and understanding of the life science curriculum.
- To understand that the real-world problems in the medial/ pharma and agriculture microbiology requires continuous acquisition of knowledge.
- To analyses, interpret and draw conclusions from quantitative/qualitative data; and critically evaluate ideas, evidence, and experiences from an open-minded and reasoned perspective.
- To acquire knowledge and skills, including "learning how to learn", that are necessary for participating in learning activities throughout life, through self-paced and self-directed learning aimed at personal development, and adapting to changing trades and demands of work place through knowledge/skill development/reskilling.
- To use ICT in a variety of learning situations, demonstrate ability to access, evaluate, and use a variety of relevant information sources.
- To acquire professional competency and entrepreneurial skills for economic empowerment.
- To demonstrate the ability to acquire, analyze, interpret, and appropriately present laboratory data.

3. Graduate Attributes in B.Sc. Microbiology

Disciplinary knowledge

Students can demonstrate comprehensive knowledge and understanding of one or more disciplines such as chemistry, biochemistry, statistics, microbiology, biotechnology regulations with support of different allied subjects of Life Science; Physical Science.

Communication Skills

Development of student's communication skills is planned through an AECC paper (English) which is compulsory for each student. Besides that, the students do various assignments that enable them to develop skills in public speaking writing and effective's interpersonal skills. Presentations in each paper enhances their confidence, ability to express themselves; presentation skills.

Research-related skills

Students develop a scientific temper and a sense of enquiry through various Microbiology / life science papers. They have capabilities in asking relevant questions relating to current issues and themes and state hypothesis and rationale for inquiry. Students can use appropriate research methodology especially for understanding issues in microbiology and reporting the results in different formats.

Cooperation/Team work

Students are capable of effective working in diverse contexts and teams in class rooms laboratories, student societies, industry, and the community. They have basic management skills for independently organizing events, resource mobilization and leading community-based projects, initiatives; cultural shows.

Self-directed learning

Students can work independently and are able to apply the concepts of Microbiology in an original; creative manner to solve and manage real life issues for the customers and industry. Students develop customized processes and or products as per the requirements of society. e. g. pasteurization of milk, antibiotic for different type of disease, biofertilizer for crops.

Multicultural competence

Students are confident of working in diverse socio-cultural contexts. They can effectively engage with multicultural groups and teams. They have sensitivities of cross cultural and ethnic diversity which they can apply to different settings. College through a student and faculty exchange program with foreign university helps them to acquire multicultural competency. They are competent to seek higher education in foreign universities.

Moral and ethical awareness/reasoning

Student has awareness of ethical conduct in different situations (academic and personal). They have skills in understanding and avoiding unethical behavior such as misrepresentation, plagiarism and environmental misuse and violence. They are formally taught ethics of research and human interventions.

Leadership readiness/qualities

Students have leadership qualities in organizing teams and their mobilization for effective problem solving in different microbiology aspects. Students apply creative leadership for realization of various goals. As a leader, they are trained to have greater customer sensitivity and connect.

Lifelong learning

Students acquire ability to gain knowledge and skills which are necessary in life for the holistic development for meeting their professional and personal needs in varying environment and changing contexts.

4. Qualification Descriptors for B.Sc. Microbiology

The following descriptors indicate the expectations from B.Sc. Microbiology:

- The students will have a sound knowledge of microbes and life science
- They will understand the science and technologies of Microbiology.
- They will understand food composition, nutritional, microbiological and sensory aspects.
- They will understand microbiology technique, both nationally and internationally.
- They will be versant with key principles of growth, reproduction, cell structure and function and the basics of genetics.

5. Program Learning Outcome in B.Sc. Microbiology

The learning outcome of the course are-

- Knowledge of various areas related to Microbiology.
- Understanding of the knowledge of various biotechnological application of microorganism and will learn industrially important substance produce by microorganism.
- Know-how of the study of all living organism, or microbes, such as bacteria, viruses, fungi, algae and the physiological, ecological and clinical aspects of these microbes.
- Relevance and significance of the development of agrochemicals and even the preservation of the environment by closely analyzing microorganism.

6. Structure of B.Sc. Microbiology.

The B.Sc. Microbiology program will be of three years duration. Each year will be called an academic year and will be divided into two semesters, thus there will be a total of six semesters. Each semester will consist of sixteen weeks.

The program will consist of core papers, general electives, and discipline electives of 6 credits, 4 credits theory and 2 credits practical courses. Skill enhancement courses are 4 credits courses which comprise of practical or theory 2 credits and Practical 2 credits. For theory classes 1 credit indicates a one-hour lecture per week while for Practical 1 credit indicates a two-hour session per week.

The program includes Core Courses (CC) and elective courses. The core courses are all compulsory courses. There are three kinds of elective courses: Inter Discipline-Course Elective (IDC), Skill Enhancement Course (SEC). In addition, there are two compulsory Ability Enhancement Courses (AEC), and Value-added courses (VAC).

To acquire a degree in microbiology. A student must study 11 Core Courses, 3 Inter Discipline-Course Electives, 4 Skill Enhancement Courses and 4 compulsory Ability Enhancement Courses. The Core Courses, credit Inter Discipline-Course Elective and 6 Value – Added Courses (VAC). The Skill Enhancement Courses are 9 credit courses while the Ability Enhancement Courses are 8 credit-courses. A student must earn a minimum of 80 credits to get a degree in B.Sc. Microbiology.

There will be 11 Core Courses which are to be compulsorily studied to complete the requirements for a degree in B.Sc. Biology The students will study two Core Courses each in Semesters I, II and III. three Core Courses each in Semesters IV, and V. four Core Courses in Semesters VI. The Core Courses will be of four credits each (four credits theory and two credits Practical).

The program offers 3 Inter Discipline-Course Electives (IDC), of which the student must choose any two in each of the Semester I, II and III will be of 9 credits each. A particular option of AEC course will be offered in Semesters I To IV semesters only if the minimum number of students opting for that course is 8 credits. A particular option of VAC will be offered in semester I and II semesters opting for that course in 6 credits.

The students will undertake 4 Skill Enhancement (SE) courses of two credits in I, II, V and 3 credit III, which they can choose from the list of SE courses offered by their respective school or other schools within CVRUK. The Department of Microbiology is offering five such courses. The 4 compulsory Ability Enhancement Courses (AECs): AE1 (Hindi language) and AE2 (English language) AE3 (Communication Skill) AE4 (Culture Heritage) will be of 8 credits each (theory only). The student will take one each in Semesters I, II, III and IV.

The teaching learning will involve theory classes of one hour duration and practical classes. The curriculum will be delivered through various methods including chalk and talk, power point presentation, audio, video tools, e-learning/e-content, field trips/ industry visits, seminars, workshops, projects, and class discussions. The assessment broadly will comprise of internal assessment (40%) and End Semester examination (60%). The internal assessment will be through MCQs, test, assignment, oral presentation, quizzes, and worksheets. Each practical paper will be of 50 marks.

BACHELOR OF SCIENCE (MICROBIOLOGY)

Duration: 36 Months (3 Years) Eligibility: **12th Pass**

COURSE STRUCTURE OF B.Sc. MICROBIOLOGY FIRST SEMESTER

Course Details				External Assessment		Internal Assessment		Credit Distribution			Allotted Credits
Course Code	Course Type	Course Title	Total Marks					L	T	P	Subject wise Distribution
				Max Marks	Min Marks	Max Marks	Min Marks				
Theory Group											
3SGMC103	Major Core	Microbiology I- (General Microbiology and Biotechnology)	100	60	20	40	14	4	-	-	4
3SDMM104	Minor Core	Botany – I (Diversity of Microbes and Cryptogams)	100	60	20	40	14	2	-	-	2
3SPIM104		Chemistry –I (Physical, Inorganic & Organic Chemistry)									
3SPHI102	Interdisciplinary Course	Public Health and Hygiene	100	60	20	40	14	3	-	-	3
3HHLA101	Ability Enhancement Course	Hindi language	100	60	20	40	14	2	-	-	2
3SEEV106/ 3IFAV106	Value Added Course	Environmental Education/ Fundamentals of AI	100	60	20	40	14	3	-	-	3
Practical Group				Term End Practical Exam		Internal Assessment		-			
3SGMC103	Practical Major Core	Microbiology I- (General Microbiology and Biotechnology)	100	60	40	40	14		-	2	2
3SDMM104	Practical Minor Core	Botany – I (Diversity of Microbes and Cryptogams)	100	60	40	40	14	-	-	2	2
3SPIM104		Chemistry –I (Physical, Inorganic & Organic Chemistry)									
3SIBS105	Skill Enhancement Course	Introduction of Basic Instrument in Biology	100	60	40	40	14		1	1	2
	Grand Total		**800**					**14**	1	**5**	**20**

Minimum Passing Marks are equivalent to Grade DL- Lectures T- Tutorials P- Practical
External theory & practical will carry 60 marks.
Internal Assessment (theory & practical will carry total of 40 marks.
Internal Assessment – Attendance 75% Pre-University Test (PUT)/ Assignments.
Note- 1. List of AEC, VAC, SEC, IDC, MAJOR and MINOR subjects are enclosed after the scheme.

BACHELOR OF SCIENCE (MICROBIOLOGY)

Duration: 36 Months (3 Years) Eligibility: **12th Pass**

COURSE STRUCTURE OF B.Sc. MICROBIOLOGY SECOND SEMESTER											
Course Details				**External Assessment**		**Internal Assessment**		**Credit Distribution**			**Allotted Credits**
Course Code	**Course Type**	**Course Title**	**Total Marks**	**Max Marks**	**Min Marks**	**Max Marks**	**Min Marks**	**L**	**T**	**P**	**Subject wise Distribution**
Theory Group											
3SBIC203	**Major Core**	Microbiology II- (Biochemistry and Immunology)	100	60	20	40	14	4	-	-	4
3SCBM204	**Minor Core**	Botany – II (Cell Biology and Genetics)	100	60	20	40	14	2	-	-	2
3SPCM204		Chemistry –II (Physical Chemistry)									
3SATI202	**Interdisciplinary Course**	Analytical Techniques	100	60	20	40	14	3	-	-	3
3HELA201	**Ability Enhancement Course**	English language	100	60	20	40	14	2	-	-	2
3SIPS205	**Skill Enhancement Course**	Intellectual Property Right	100	60	20	40	14	2	-	-	2
3ICSV206/ 3HYEV206/ 3HCIV206	**Value Added Course**	Cyber Security / (*Yoga Education / Contemporary India	100	60	20	40	14	3	-	-	3
Practical Group				**Term End Practical Exam**		**Internal Assessment**		-			
3SBIC203	**Practical Major Core**	Microbiology II- (Biochemistry and Immunology)	100	60	20	40	14		-	2	2
3SCBM204	**Practical Minor Core**	Botany – II (Cell Biology and Genetics)	100	60	20	40	14	-	-	2	2
3SPCM204		Chemistry –II (Physical Chemistry)									
	Grand Total		**800**					**16**	-	**4**	**20**

BACHELOR OF SCIENCE (MICROBIOLOGY)

Duration: 36 Months (3 Years) Eligibility: **12th Pass**

COURSE STRUCTURE OF B.Sc. MICROBIOLOGY SECOND SEMESTER

***For value added course Yoga Education credit distribution will be**

Practical Group			Total Marks	Max Marks	Min Marks	Max Marks	Min Marks	L	T	P	Total Credit
3HYEV206	Value Added Course	*Yoga Education	100	60	20	40	14	-	1	2	3

Minimum Passing Marks are equivalent to Grade DL- Lectures T- Tutorials P- Practical
External theory & practical will carry 60 marks.
Internal Assessment (theory & practical will carry total of 40 marks.
Internal Assessment – Attendance 75% Pre-University Test (PUT)/ Assignments.
Note- 1. List of AEC, VAC, SEC, IDC, MAJOR and MINOR subjects are enclosed after the scheme.
After Second Sem
Student exiting the programme after securing 40 credits will be awarded UG Certificate in the relevant Discipline/Subject provided they secure 4 credits in work based vocational courses offered during summer term or internship/ apprenticeship in addition to 6 credits from skill- based courses earned during first and second semester.

BACHELOR OF SCIENCE MICROBIOLOGY

Duration: 36 Months (3 Years) Eligibility: **12th Pass**

COURSE STRUCTURE OF B.Sc. MICROBIOLOGY THIRD SEMESTER

Course Details				External Assessment		Internal Assessment		Credit Distribution			Allotted Credits
Course Code	Course Type	Course Title	Total Marks	Max Marks	Min Marks	Max Marks	Min Marks	L	T	P	Subject wise Distribution
Theory Group											
3SPBC303	Major Core	Microbiology III- (Principle of Bioinstrumentation and Techniques	100	60	20	40	14	4	-	-	4
3SBSM304	Minor Core	Botany III - (Biodiversity and Systematic of Seed Plant)	100	60	20	40	14	4	-	-	4
3SPIM304		Chemistry III- (Physical, Inorganic and Organic Chemistry)									
3HCSA301	Ability Enhancement Course	Communication Skill	100	60	20	40	14	2	-	-	2
Practical Group				Term End Practical Exam		Internal Assessment					
3SPBC303	Practical Major Core	Microbiology III-(Principle of Bioinstrumentation and Techniques	100	60	20	40	14		-	2	2
3SBSM304	Practical Minor Core	Botany – III (Biodiversity and Systematic of Seed Plant)	100	60	20	40	14	-	-	2	2
3SPIM304		Chemistry- III (Physical, Inorganic and Organic Chemistry)									
3SNGS305	Skill Enhancement Course	Nursery and Gardening	100	60	20	40	14		1	2	3
3SMCI302	Interdisciplinary Course	Mushroom Cultivation	100	60	20	40	14		1	2	3
	Grand Total		700					10	2	8	20

Minimum Passing Marks are equivalent to Grade DL- Lectures T- Tutorials P- Practical

External theory & practical will carry 60 marks.

Internal Assessment (theory & practical will carry total of 40 marks.

Internal Assessment – Attendance 75% Pre-University Test (PUT)/ Assignments.

Note- 1. List of AEC, VAC, SEC, IDC, MAJOR and MINOR subjects are enclosed after the scheme.

BACHELOR OF SCIENCE MICROBIOLOGY

Duration: 36 Months (3 Years) Eligibility: **12th Pass**

COURSE STRUCTURE OF B.Sc. MICROBIOLOGY FOURTH SEMESTER

Course Details				External Assessment		Internal Assessment		Credit Distribution			Allotted Credits
Course Code	Course Type	Course Title	Total Marks	Max Marks	Min Marks	Max Marks	Min Marks	L	T	P	Subject wise Distribution
Theory Group											
3SEMC403	Major Core - I	Microbiology IV- (Environmental and Medical Microbiology)	100	60	20	40	14	4	-	-	4
3SFMC403	Major Core - II	Microbiology IV- Food Microbiology	100	60	20	40	14	4	-	-	4
3SSDM404	Minor Core	Botany – IV (Structure Development & Reproduction in Flowering Plant)	100	60	20	40	14	4	-	-	4
3SPOM404		Chemistry –IV (Physical, Organic and Inorganic Chemistry)									
3HCHA401	Ability Enhancement Course	Cultural Heritage	100	60	20	40	14	2	-	-	2
Practical Group				Term End Practical Exam		Internal Assessment					
3SEMC403	Practical Major Core-I	Microbiology IV- (Environmental and Medical Microbiology)	100	60	20	40	14		-	2	2
3SFMC403	Practical Major Core-II	Microbiology IV- Food Microbiology	100	60	20	40	14	-	-	2	2
3SSDM404	Practical Minor Core	Botany – IV (Structure Development & Reproduction in Flowering Plant)	100	60	20	40	14	-	-	2	2
3SPOM404		Chemistry –IV (Physical, Organic and Inorganic Chemistry)									
	Grand Total		**700**					**14**	-	**6**	**20**

External theory & practical will carry 60 marks.

Internal Assessment (theory & practical will carry total of 40 marks.

Internal Assessment – Attendance 75% Pre-University Test (PUT)/ Assignments.

Note- 1. List of AEC, VAC, SEC, IDC, MAJOR and MINOR subjects are enclosed after the scheme.

After IV Sem - Student exiting the programme after securing 80 credits will be awarded UG Diploma in the relevant Discipline/Subject provided they secure additional 4 credit in skill based vocational courses offered during first year or second year summer term.

BACHELOR OF SCIENCE MICROBIOLOGY

Duration: 36 Months (3 Years) Eligibility: **12th Pass**

COURSE STRUCTURE OF B.Sc. MICROBIOLOGY FIFTH SEMESTER

Course Details				External Assessment		Internal Assessment		Credit Distribution			Allotted Credits
Course Code	Course Type	Course Title	Total Marks	Max Marks	Min Marks	Max Marks	Min Marks	L	T	P	Subject wise Distribution
Theory Group											
3SIAC503	Major Core - I	Microbiology V- (Industrial and Agriculture Microbiology)	100	60	20	40	14	4	-	-	4
3SMGC503	Major Core - II	Microbiology V- (Microbial Genetics)	100	60	20	40	14	2	-	-	2
3SMPC503	Major Core - III	Microbiology V- (Microbial Physiology)	100	60	20	40	14	2	-	-	2
3SIBM504	Minor Core	Botany V - (Industrial Botany)	100	60	20	40	14	2	-	-	2
3SRMM504		Chemistry V - (Research Methodology for Chemistry									
Practical Group				**Term End Practical Exam**		**Internal Assessment**					
	Practical	-	-	-	-	-	-	-	-	-	-
3SIAC503	Practical Major Core-I	Microbiology V- (Industrial and Agriculture Microbiology)	100	60	20	40	14		-	2	2
3SMGC503	Practical Major Core-II	Microbiology V- (Microbial Genetics)	100	60	20	40	14		-	2	2
3SMPC503	Practical Major Core-III	Microbiology V- (Microbial Physiology)	100	60	20	40	14		-	2	2
3SIBM504	Practical Minor Core	Botany V - (Industrial Botany)	100	60	20	40	14	-	-	2	2
3SRMM504		Chemistry V - (Research Methodology for Chemistry									
Skill Course											
3SIPS505	Skill Enhancement Course	(Internship Base/project base)	100	60	20	40	14	-	1	1	2
	Grand Total		**900**					**10**	**1**	**9**	**20**

Minimum Passing Marks are equivalent to Grade DL- Lectures T- Tutorials P- Practical
External theory & practical will carry 60 marks.
Internal Assessment (theory & practical will carry total of 40 marks.
Internal Assessment – Attendance 75% Pre-University Test (PUT)/ Assignments.
Note- 1. List of AEC, VAC, SEC, IDC, MAJOR and MINOR subjects are enclosed after the scheme

BACHELOR OF SCIENCE MICROBIOLOGY

Duration: 36 Months (3 Years) Eligibility: **12th Pass**

COURSE STRUCTURE OF B.Sc. MICROBIOLOGY SIXTH SEMESTER

Course Details				External Assessment		Internal Assessment		Credit Distribution			Allotted Credits
Course Code	Course Type	Course Title	Total Marks	Max Marks	Min Marks	Max Marks	Min Marks	L	T	P	Subject wise Distribution
Theory Group											
3SMGC603	Major Core - I	Microbiology VI - (Molecular Biology and Genetic Engineering)	100	60	20	40	14	4	-	-	4
3SAMC603	Major Core - II	Microbiology VI - (Analytical Microbiology)	100	60	20	40	14	4	-	-	4
3SICC603	Major Core - III	Microbiology VI - (Immunology and Clinical Microbiology)	100	60	20	40	14	2	-	-	2
3SPRM604	Minor Core	Botany VI - (Plant Reproduction)	100	60	20	40	14	2	-	-	2
3SBIM604		Chemistry VI - (Biochemistry)									
Practical Group				**Term End Practical Exam**		**Internal Assessment**					
3SMGC603	Practical Major Core- I	Microbiology VI - (Molecular Biology and Genetic Engineering)	100	60	20	40	14	-	-	2	2
3SAMC603	Practical Major Core-II	Microbiology VI - (Analytical Microbiology)	100	60	20	40	14	-	-	2	2
3SICC603	Practical Major Core-III	Microbiology VI - (Immunology and Clinical Microbiology)	100	60	20	40	14	-	-	2	2
3SPRM604	Practical Minor Core-	Botany VI - (Plant Reproduction)	100	60	20	40	14	-	-	2	2
3SBIM604		Chemistry VI - (Biochemistry)									
	Grand Total		**800**					**12**	-	**8**	**20**

Minimum Passing Marks are equivalent to Grade DL- Lectures T- Tutorials P- Practical

External theory & practical will carry 60 marks.

Internal Assessment (theory & practical will carry total of 40 marks.

Internal Assessment – Attendance 75% Pre-University Test (PUT)/ Assignments.

Note- 1. List of AEC, VAC, SEC, IDC, MAJOR and MINOR subjects are enclosed after the scheme

Credit Distribution in B.Sc. (Microbiology)

Semester	Course Code	Course Name (Major)	Credits (L +T +Pr.)
I	3SGMC103	Microbiology I-General microbiology and biotechnology	6(4+0+2)
II	3SBIC203	Microbiology II- Biotechnology and Immunology	6(4+0+2)
III	3SPBC303	Microbiology III- Principle of bioinstrumentation and techniques	6(4+0+2)
IV	3SEMC403	Microbiology IV- Major I - Environmental and Medical Microbiology	6(4+0+2)
	3SFMC403	Major II - Food Microbiology	6(4+0+2)
V	3SIAC503	Major I - Microbiology (Industrial and Agriculture Microbiology)	6(4+0+2)
	3SMGC503	Major II - Microbiology (Microbial Genetics)	4(2+0+2)
	3SMPC503	Major III -Microbiology (Microbial Physiology)	4(2+0+2)
VI	3SMGC603	Major I -Microbiology (Molecular Biology and Genetic Engineering)	6(4+0+2)
	3SAMC603	Major II -Microbiology (Analytical Microbiology)	6(4+0+2)
	3SICC603	Major III -Microbiology (Immunology and Clinical Microbiology)	4(2+0+2)

Semester	Course Code	Course Name (Minor)	Credits (L +T +Pr.)
I	3SDMM104	Botany – I (Diversity of Microbes and Cryptogams)/	4(2+0+2)
	3SPIM104	Chemistry- I (Physical, Inorganic and Organic Chemistry)	4(2+0+2)
II	3SCBM204	Botany – II (Cell biology and Genetics)	4(2+0+2)
	3SPCM204	Chemistry –II (Physical Chemistry)	4(2+0+2)
III	3SBSM304	Botany – III (Biodiversity and systematic of seed plant)	6(4+0+2)
	3SPIM304	Chemistry- III (Physical, Inorganic and Organic Chemistry)	6(4+0+2)
IV	3SSDM404	Botany – IV (Structure Development and Reproduction in flowering plant)/	6(4+0+2)
	3SPOM404	Chemistry –IV (Physical, Organic and Inorganic Chemistry)	6(4+0+2)
V	3SIBM504	Botany – V (Industrial Botany)	4(2+0+2)

Semester	Course Code	Course Name (Minor)	Credits (L +T +Pr.)
	3SRMM504	Chemistry –V (Research methodology for Chemistry)	4(2+0+2)
VI	3SPRM604	Botany VI (Plant Reproduction)	4(2+0+2)
	3SBIM604	Chemistry-VI (Biochemistry)	4(2+0+2)

Value Added Course			
Semester	**Course Code**	**Course Name**	**Credits (L +T +Pr.)**
1st	3IFAV106	Fundamentals of AI	3(3+0+0)
1st	3SEEV106	Environmental Education	3(3+0+0)
2nd	3ICSV206	Cyber Security	3(3+0+0)
2nd	3HCIV206	Contemporary India	3(3+0+0)
2nd	3HYEV206	Yoga Education	3(0+1+2)

Inter Discipline Course			
Semester	**Course Code**	**Course Name**	**Credits (L +T +Pr.)**
I, II and III Sem	3SPHI102	Public Health and Hygiene	3(3+0+0)
	3SATI202	Analytical Techniques	3(3+0+0)
	3SMCI302	Mushroom Cultivation	3(0+1+2)

SKILL ENHANCEMENT ELECTIVE COURSES			
Semester	**Course Code**	**Course Name**	**Credits (L +T+ Pr.)**
1st	3SIBS105	Introduction Of Basic Instrument in Biology	2(0+1+1)
2nd	3SIPS205	Intellectual Property Right	2(2+0+0)
3rd	3SNGS305	Nursery and Gardening	3(0+1+2)
5th	3SIPS505	Internship Base / Project	2(0+1+1)

Ability Enhancement Course			
Semester	**Course Code**	**Course Name**	**Credits (L +T +Pr.)**
1st	3HHLA101	Hindi language	2(2+0+0)
2nd	3HELA201	English Language	2(2+0+0)
3rd	3HCSA301	Communication Skill	2(2+0+0)
4th	3HCHA401	Cultural Heritage	2(2+0+0)

Semester-wise Distribution of Courses

Semester	Course Opted	Course Name	Credits
I	**Value Added Course**	Fundamentals of AI Environmental Education	3
	Ability Enhancement Course	Hindi language	2
	Skill Enhancement Course	Introduction Of Basic Instrument in Biology	2
	Inter Discipline Course	Public Health and Hygiene	3
	Major Core	Microbiology	4
	Minor Core	Botany/ Chemistry	2
	Major Core Practical	Microbiology	2
	Minor Core Practical	Botany/ Chemistry	2
II	**Value Added Course**	Cyber Security/ Contemporary India Yoga education	3
	Ability Enhancement Course	English language	2
	Skill Enhancement Course	Intellectual Property Right	2
	Inter Discipline Course	Analytical technique	3
	Major Core	Microbiology	4
	Minor Core	Botany/ Chemistry	2
	Major Core Practical	Microbiology	2
	Minor Core Practical	Botany/ Chemistry	2
III	**Ability Enhancement Course**	Communication Skill	2
	Skill Enhancement Course	Nursery and Gardening	3
	Inter Discipline Course	Mushroom Cultivation	3
	Major Core	Microbiology	4
	Minor Core	Botany/ Chemistry	2
	Major Core Practical	Microbiology	2
	Minor Core Practical	Botany/ Chemistry	2
IV	**Ability Enhancement Course**	Cultural Heritage	2
	Major Core - I	Microbiology	4
	Major Core - II	Microbiology	4
	Minor Core	Botany/ Chemistry	4
	Major Core-I Practical	Microbiology	2

Semester	Course Opted	Course Name	Credits
	Major Core-II Practical	Microbiology	2
	Minor Core Practical	Botany/ Chemistry	2
V	**Skill Enhancement Course**	Aquarium fish keeping	2
	Major Core – I	Microbiology	4
	Major Core – II	Microbiology	2
	Major Core – III	Microbiology	2
	Minor Core	Botany/ Chemistry	2
	Major Core-I Practical	Microbiology	2
	Major Core-II Practical	Microbiology	2
	Major Core-III Practical	Microbiology	2
	Minor Core Practical	Botany/ Chemistry	2
VI	**Major Core - I**	Microbiology	4
	Major Core - II	Microbiology	4
	Major Core - III	Microbiology	2
	Minor Core	Botany/ Chemistry	2
	Major Core- I Practical	Microbiology	2
	Major Core-II Practical	Microbiology	2
	Major Core-III Practical	Microbiology	2
	Minor Core- Practical	Botany/ Chemistry	2
		Total	120 Credits

Total Credits: 60 CC + 28 MINORS + 09 IDE + 08 AEC + 09 SEC + 06 VAC = 120 Credits

BACHLOR OF SCIENCE

(Microbiology)

(B. Sc. (Microbiology) – CKUG04C03)

I Semester

MAJOR CORE COURSES -I

3SGMC103: Microbiology I -General Microbiology and Biotechnology
(Credits: Theory-4 Practical-2)

Scheme of Examination

Course Code	Course Name	Credits	Maximum Marks Allotted						Duration of exam	
			Theory			Practical		Total	Theory	Practical
			End Sem	Mid Sem	Assign	End Sem	Term Sem			
3SGMC103	General Microbiology and Biotechnology	6(4-0-2)	60	20	20	60	40	200	3hr	2hrs

Course Objectives

- The main objective of this course is to give students an insight into the world of microorganisms.
- The paper discusses the historical developments and major milestones leading to the development of microbiology as a separate discipline of science.
- The students will understand the diversity, structure, evolution and impact of microbes in our day-to-day life and for the sustenance of life on Earth in general.

Course Learning Outcomes

- Understand the historical progression of microbiology, including pivotal discoveries, debates, and the contributions of key scientists, shaping our understanding of microbial life.
- Develop skills in classifying microorganisms based on principles of taxonomy, recognizing their diversity and economic significance.
- Acquire proficiency in fundamental laboratory techniques for studying microorganisms, including microscopy, culture methods, sterilization, and media preparation.
- Gain a comprehensive understanding of the characteristics, distribution, and economic importance of different groups of microorganisms, both cellular and acellular.
- Explore the molecular aspects of microbiology, including nucleic acid structure, gene expression, and regulation, enhancing understanding of genetic mechanisms in prokaryotes and eukaryotes.

Syllabus (CREDITS 4-0-2)

UNIT - I

History of Development of Microbiology; History Discovery and Development of Microbial World, Spontaneous generation vs biogenesis, Fermentation, Germ Theory of Disease, Contribution of following scientists in the field Microbiology: Anton von Leeuwenhoek, Joseph Lister, Paul Ehrlich, Edward Jenner, Louis Pasteur, Robert Koch, Sergei N. Winogradsky, Alexander Fleming, Selman A. Waksman, Norman Pace, Carl Woese and Ananda M. Chakraborty

UNIT – II

Diversity of microbial world: principle of classification, classification of viruses, Bacteria (including *Cyanobacteria*), Fungi. Structure, Functional organization and Economic importance of bacteria (Gram Positive and Gram Negative) and viruses (Plants and Animals).

UNIT – III

Methods of studying microorganism: Origin of microbes, microscopy, pure culture techniques, Sterilization, Aseptic techniques, isolation of pure culture, conditions and media for growth of microorganisms in the laboratory.

UNIT - IV

General characteristics of different groups: A cellular microorganism (Viruses, Viroid, Prions) and Cellular Microorganisms (Bacteria, Algae, Fungi and Protozoa) with emphasis on distribution and occurrence, Morphology, mode of reproduction and economic importance.

UNIT – V

Nucleic Acid; DNA Structure, types and replication, RNA Structure (m RNA, t RNA, r RNA) and types and Function, Structure of gene old and new concept. Structure of gene, genetic code, transfer of genetic information; transcription, translation, protein synthesis, ribosomes. Regulation of gene expression in prokaryotes and eukaryotes

Practical: - **(Credits 2)**

- Study of the life history of the following scientists and their contributions with the help of their photographs: Anton von Leeuwenhoek, Joseph Lister, Paul Ehrlich, Edward Jenner, Louis Pasteur, Robert Koch.
- To study the principle and applications of important instruments (biological safety cabinets, autoclave, incubator, BOD incubator, hot air oven) used in the Microbiology laboratory.
- To study the Preparation of solid/ liquid culture media.
- To study the Sterilization techniques.
- To study the Isolation of single colonies on solid media.
- To study the Enumeration of Bacterial numbers by serial dilution and plating.
- To study the Simple and differential staining.
- To study the Measurement of microorganism (micrometry) and Camera Lucida drawings of isolated organism.
- To study the Gram Positive and Gram-Negative Bacteria test.

Textbook

1. A Textbook of Microbiology by D. K. Maheshwari.
2. Microbiology book by – Michael J. Pelczer and L.C.S. Chain.
3. Textbook of Microbiology" by Ananthanarayan and Paniker - Published by Universities Press.

Reference Book

1. **Microbiology: An Introduction** by Gerard J. Tortora, Berdell R. Funke, and Christine L. Case - Published by Pearson Education.
2. **Brock Biology of Microorganisms** by Michael T. Madigan, John M. Martinko, and Kelly S. Bender - Published by Pearson Education.
3. **Prescott's Microbiology** by Joanne Willey, Linda Sherwood, and Christopher J. Woolverton - Published by McGraw-Hill Education.
4. **Molecular Biology of the Cell** by Bruce Alberts, Alexander Johnson, Julian Lewis, David Morgan, Martin Raff, Keith Roberts, and Peter Walter - Published by Garland Science.

Facilitating the achievement of course learning objectives

Unit No.	Course learning outcomes	Teaching and learning activities	Assessment tasks
1.	Student will be acquainted with the historical account and development of microbiology as a scientific discipline.	Theory class focusing on discussion about the history, the important discovery and milestones achieved through the evolution of microbiology since ancient time to present scenario.	Multiple choice questions, quiz, Class test and students' presentation.
2.	Student will have gained knowledge on Classifying viruses, bacteria (including cyanobacteria), and fungi is an essential part of understanding the diversity of microorganisms on Earth.	Students should grasp them remarkable diversity of viruses, bacteria, and fungi, both in terms of their structures and life processes.	Multiple choice questions, quiz, Class test and students' presentation.
3.	Knowledge of growth culture and laboratory methods method's pure culture, conditions and media for growth of microorganisms in the laboratory.	Theory class focusing on discussion about pure culture, conditions, and media for growth of microorganisms in the laboratory.	Multiple choice questions, match the following, students' presentation,
4.	Students should be aware of the concept of DNA supercoiling and its importance in compacting DNA into the tiny space of a cell's nucleus, making it accessible for various cellular processes.	composition, types and processing of genetic material in microbes.	quiz, class test focusing on short notes and definitions.
5.	Learners should compare and contrast how gene expression is controlled in prokaryotes and eukaryotes, highlighting the complexity of eukaryotic gene regulation due to compartmentalization and chromatin structure.	Theory classes and discussion on gene, genetic code, transfer of genetic information.	Class tests, assignments, quiz, student presentations.

***Assessment tasks listed here are indicative and may vary.**

MINOR CORE COURSES

3SDMM104: Botany-I (Diversity of Microbes and Cryptogams)
(Credits: Theory-2 Practical-2)

Scheme of Examination

Course Code	Course Name	Credits	Maximum Marks Allotted						Duration of exam	
			Theory			Practical		Total	Theory	Practical
			End Sem	Mid Sem	Assign	End Sem	Term Sem			
3SDM M104	Botany-I (Diversity of Microbes and Cryptogams)	4(2-0-2)	60	20	20	60	40	200	3hr	2hr

Course Objectives

- To make the student know the outline of origin and evolution of life.
- Understand the structure of bacteria and viruses and plant diseases caused by Bacteria and viruses and their control.
- To make students learn the general characters and economic importance of algae and fungi.
- To make the students understand the vegetative and reproductive.
- Features of different algae and fungi through the study of representative types of various classes.

Course Learning Outcome

- Study of Pteridophytes and Gymnosperms will help the students understand the connecting link between the lower and higher organisms in the plant kingdom.
- The anatomy imparts a thorough knowledge about the internal structure and relationship between tissues and evolution.
- Most of the techniques in biotechnology uses bacteria, viruses and fungi. This course will make the students adept in the structure and functions of these microbes which in turn will give them confidence to work using this org.

Syllabus Credits: 2-0-2

UNIT – I

Viruses and Prokaryotes: Characteristics of Viruses. General account of TMV and T4 bacteriophage. Bacterial structure, nutrition, reproduction and economic importance. General account of Mycoplasma, Cyanobacteria and actinomycetes.

UNIT- II

Algae: General characters, classification and economic importance; important features and life history of Chlorophyceae-*Volvox*, *Oedogonium*, Charophyceae-*Chara* Xanthophyceae - *Vaucheria*, Phaeophyceae - *Ectocarpus*, *Sargassum*, Rhodophyceae -*Polysiphonia*.

UNIT- III

Fungi: General characters, classification and economic importance, important features and life history of Mastigomycotina: *Phytophthora*, Zygomycotiana: *Mucor*. Ascomycotina: *Aspergillus*, *Yeast Peziza*, Basidomycotina: *Puccinia*, Deurteromycotina: *Cercospora*, *Colletotrichum*. General account of lichens.

UNIT- IV

Bryophyta: General characters and classification, study of morphology, Anatomy, Reproduction of Hepaticopsida: *Riccia*, *Marchantia*, Anthrocerotopsida: *Anthoceros*, Bryopsida: *Polytrichum.*

UNIT-V

Pteridophyta: Important characters and classification. Stellar organization. Morphology and anatomy of *Rhynia*. Structure, anatomy and reproduction in *Lycopodium*, *Selaginella*, *Equisetum* and *Marsilea*.

Practical Content **Credits: 2**

1. Study of *volvox* by preparing temporary slide.
2. Study of *oedogonium* by preparing temporary slide.
3. Study of *chara* by preparing temporary slide.
4. Study of *polysiphonia* by preparing temporary slide.
5. Study of *mucor* by preparing temporary slide.
6. Study of *aspergillus* by preparing temporary slide.
7. Study of *peziza* by preparing temporary slide.
8. Study of *puccinia* by preparing temporary slide.
9. To study external morphology of *riccia thallus*.
10. To study external morphology of *marchantia thallus*.

Reference Book

- Hait. Bhattachary. Ghosh Vol 1st and Vol 2nd A Text Book of Botany.
- Gangulee and Kar Vol 1st and Vol 2nd College Botany.
- H.D. Kumar (1999). Introductory Phycology. Affiliated East-West Press, Delhi.
- Pelczar. M.J. (2001) Microbiology, 5th edition, Tata McGraw-Hill Co, New Delhi.
- Botany for Degree Students Pteridophyta Dr. P.C. Vashishta and Dr. A.K. Sinha, Dr. Anil Kumar (2010). S. Chand. Delhi, India.

Text book

- Introduction to Bryophytes by- Alain Vanderpoorten and Bernard Goffinet - Focuses specifically on bryophytes, including mosses and liverworts.
- Introduction to Algae by-Graham P. Harris - Offers insights into the diverse world of algae, spanning green, brown, and red algae.
- Introduction to Fungi by John Webster and Roland W.S. Weber - Provides a comprehensive overview of fungal biology.
- S.B Agrawal, V.K Agrawal and Amit Agrawal, Unified, Vanaspati Vigyan.

Facilitating the achievement of course learning objectives

Unit No.	Course Learning Outcome	Teaching and Learning Activities	Assessment Tasks
1	Understand the interactions between viruses and host cells, including viral tropism and host cell receptors. Explain how viruses evade host immune responses.	Explain the structure of viruses and their classification based on genetic material, shape, and other characteristics. Use visual aids, diagrams, and models to facilitate understanding.	Class test focusing on definitions and short questions.
2	Understand the different modes of reproduction in algae, including asexual and sexual reproduction, and be able to describe the life cycles of common algal groups.	Conduct practical sessions where students can observe different types of algae under microscopes. Teach them how to prepare slides and identify algae based on their features.	Class test focusing on definitions and long subjective questions.

Unit No.	Course Learning Outcome	Teaching and Learning Activities	Assessment Tasks
3	Analyse the ecological roles of fungi in various ecosystems, including decomposition, mycorrhizal associations, and symbiotic relationships with other organisms.	Students can observe fungi under microscopes. They can collect samples from different sources, like mouldy bread, soil, or mushrooms. This will help them learn about fungal structures and reproduction.	Class test focusing on definitions and long subjective questions.
4	Students should grasp the alternation of generations life cycle in bryophytes, including the roles of gametophytes and sporophytes. They should be able to explain how bryophytes reproduce both sexually and asexually.	Ask students to create models or diagrams of the bryophyte life cycle, including the gametophyte and sporophyte stages. This can be done individually or in small groups.	class quizzes or short tests that assess your understanding of specific lecture topics.
5	Describe the alternation of generations in pteridophytes, including the gametophyte and sporophyte phases. Explain the process of spore formation, release, and germination in pteridophytes.	Use props or drawings to simulate the process of fern reproduction. Students can act as gametophytes and sporophytes to demonstrate the alternation of generations. This hands-on activity can help students grasp the concept more effectively.	Class test, quiz and multiple-choice questions.

MINOR CORE COURSES

3SPIM104: Chemistry –I (Physical, Inorganic and Organic Chemistry

(Credits: Theory-2 Practical-2)

Scheme of Examination

Course Code	Course Name	Credits	Maximum Marks Allotted						Duration of exam	
			Theory			Practical				
			End Sem	Mid Sem	Assign	End Sem	Term Sem	Total	Theory	Practical
3SPIM104	Chemistry –I (Physical, Inorganic and Organic Chemistry	4(2-0-2)	60	20	20	60	40	200	3 hr	2 hr

Course Objectives

- Mastering math tools for problem-solving in chemistry.
- Understanding gas behavior and critical phenomena.
- Analyzing molecular structures and crystallography.
- Comparing properties and complexation tendencies.
- Grasping bonding, reactions, and stereochemistry principles.

Course Learning Outcomes

- Ability to apply logarithmic relations, differentiate functions, and calculate slopes for chemical applications.
- Understanding of gas laws, critical phenomena, and molecular dynamics.
- Proficiency in analyzing molecular structures, intermolecular forces, and crystallography.
- Competence in comparing properties, understanding complexation tendencies, and identifying key characteristics.
- Profound understanding of bonding, reaction mechanisms, and stereochemical principles in organic compounds.

Syllabus Credits 2-0-2

Physical Chemistry

UNIT – I

Gaseous States

Critical phenomenon: PV isotherms of ideal gases, continuity of states, the isotherms of van der Waals equations.

Molecular Velocities

Root mean square, average and most probable velocities. Qualitative discussion of the maxwell's distribution of molecular velocities, collision numbers, mean free path and collision diameter.

UNIT –II

Liquid State

Intermolecular forces, structure of liquids (a qualitative description). Liquid crystals: Difference between liquid crystal, solid and liquid. Classification, structure of nematic and cholesteric phases.

Inorganic Chemistry

UNIT – III

s-Block Elements

Comparative study Li and Mg, diagonal relationships, salient features of hydrides, solvation and complexation tendencies including their function in biosystems, an introduction to alkyls and aryls.

p-Block Elements

Comparative study Be and Al (including diagonal relationship) of groups 13-17 elements, compounds like hydrides, oxides, oxyacid and halides of groups 13-16.

Organic Chemistry

UNIT – IV

Structure and Bonding

Hybridizations, bond lengths and bond angles, bond energy, Localized and delocalized chemical bond, van-der Waals interactions, inclusion compounds, clathrates, charge transfer complexes, resonance, hyper- conjugation, aromaticity, inductive and field effects, hydrogen bonding.

Mechanism of Organic Reactions

Homolytic and heterolytic bond breaking. Types of Reagents- electrophiles and nucleophiles. Types of organic reactions, energy consideration.

UNIT – V

Stereochemistry of Organic Compounds

Concept of isomerism, types of isomerism, optical isomerism, elements of symmetry, molecular chirality, enantiomers, stereo genic centers, optical activity, properties of enantiomers, diastereomers, mesocompounds, resolution of enantiomers, inversion, retention and racemization.

Practical Content — Credits :2

Physical Chemistry

- Calibration of thermometer.
- Determination of melting point.
- Determination of boiling point

Inorganic Chemistry

- Separation of cations by paper chromatography.
- Preparation of ferrous alum.

Organic Chemistry

- Distillation.
- Crystallization.
- Sublimation.

Text Books

- Unified Chemistry by Tandon, Rathore and Agarwal.
- Physical Chemistry by P. W. Atkins and Julio de Paula.
- Inorganic Chemistry by Gary L. Miessler, Paul J. Fischer, and Donald A. Tarr.
- Organic Chemistry by Jonathan Clayden, Nick Greeves, and Stuart Warren.
- Principles of Instrumental Analysis by Douglas A. Skoog, F. James Holler, and Stanley R. Crouch.

- Solid State Chemistry and its Applications by Anthony R. West.

Reference Books

- Physical Chemistry Thermodynamics, Structure, and Change by Peter Atkins and Julio de Paula.
- Inorganic Chemistry by Catherine and Alan G. Sharpe.
- Organic Chemistry by Francis A. Carey and Richard J. Sundberg.
- Solid State Chemistry an Introduction" by Leslie E. Smart and Elaine A. Moore.
- Principles of Instrumental Analysis by Douglas A. Skoog, F. James Holler, and Stanley R. Crouch.

Facilitating the achievement of course learning objectives

Unit No.	Course Learning Outcome	Teaching and Learning Activities	Assessment Tasks
1	Developing critical thinking skills and an appreciation for the broader context of mathematics in various fields and basics concept of gaseous states and molecular velocities.	Conduct traditional lectures to introduce fundamental mathematical concepts such as moles, stoichiometry and gas laws. Use visuals, diagrams, and real-world examples to make these concepts relatable.	Homework assignments requiring calculations of slopes, integration of functions, and probability problems.
2	Intermolecular forces (hydrogen bonding, dipole-dipole interactions, London dispersion forces) influence liquid properties.	Begin with traditional lectures to introduce the fundamental concepts of the liquid state, including properties, intermolecular forces, and phase transitions.	Lab report on the determination of molecular velocities and collision parameters.
3	Collision theory and explain how it relates to reaction rates and the role of reactant collisions in chemical reactions.	Provide examples of reactions and guide students through the derivation of rate laws from experimental data, emphasizing the determination of reaction order.	Written exam assessing understanding of liquid crystals, crystallography, and diffraction techniques.
4	The basic structure of an atom, including the nucleus, electrons, protons, and neutrons. Explain the significance of atomic number and mass number.	Begin with interactive lectures that introduce key concepts of atomic structure, electron configuration, and chemical bonding. Use visual aids, models, and demonstrations to engage students.	Class quizzes or short tests that assess your understanding of specific lecture topics.
5	Define stereochemistry as the study of the spatial arrangement of atoms or groups of atoms in molecules and its impact on chemical properties.	Conduct interactive workshops where students practice assigning R and S configurations to stereo centres using the Cahn-Ingold-Prelog rules. Provide practice problems and molecular models.	Lab report on the application of spectroscopic techniques in structural analysis.

INTER DISCIPLINARY COURSE

3SPHI102: Public Health and Hygiene

(Credits: Theory- 3, Tutorials- 0)

Scheme of Examination

Course Code	Course Name	Credit	Maximum marks Allotted						Duration of Exam.	
			Theory			Practical		Total	Theory	Practical
			End Sem	Mid Sem	Assign	End Sem	Term Sem			
3SPHI102	Public Health and Hygiene (1st Sem)	3(3-0-0)	60	20	20	-	-	100	3hr	-

Course Objective

- To enlighten the non-major elective students about the general knowledge on their health and hygiene.
- To create general health awareness, the hazardous impacts and remedy.

Course Learning Outcomes

- These outcomes cover a wide range of topics related to public health, nutrition, environmental health, disease prevention, and health education.
- They aim to equip learners with essential knowledge and skills for promoting and maintaining community health.

Syllabus: Credits 3-0-0

Unit 1:

Scope of Public health and Hygiene – nutrition and health – classification of foods bases on nutritional value – Nutritional deficiency diseases Vitamin deficiency diseases.

Unit 2:

Environment and Health hazards: Environmental degradation – Pollution – Air (causes and prevention), Water– Air (causes and prevention), Land– Air (causes and prevention) and Noise associated health hazards.

Unit 3:

Communicable diseases. Measles diseases and their preventive and control measures, Malaria diseases and their preventive and control measures, Hepatitis diseases and their preventive and control measures, Cholera, Filariasis diseases and their preventive and control measures, HIV /AIDS.

Unit 4:

Non-Communicable diseases and their preventive measures. Genetic diseases, Cancer, Cardio vascular diseases, Chronic respiratory disease, Diabetes, Epilepsy,

Unit 5:

Health Education in India – WHO Programs – Government and Voluntary Organizations and their health services – Precautions, First Aid and awareness on epidemic/sporadic diseases.

Text Book

- Park and Park, 1995: Text Book of Preventive and Social Medicine – Banarsidas Bhanot Publ. Jodhpur – India.
- Text Book of Public Health and hygiene, zoology by Dr. A. P. Ekhande, Dr. N. G. Mahajan, Dr. M. C. Patil, Dr. Manojkumar Chopda, Dr. R. M. Chaudhari, Prashant Publication.
- "Public Health and Community Medicine" by Rajvir Bhalwar (Publisher: CBS Publishers & Distributors Pvt Ltd)

Reference Books

- Verma, S. 1998: Medical Zoology, Rastogi publ. – Meerut – India
- Singh, H.S. and Rastogi, P.: Parasitology, Rastogi Publ. India.
- Dubey, R.C and Maheshwari, D.K. 2007: Text Book of Microbiology S. Chand and Co. Publ. New Delhi – India.

Facilitating the achievement of course learning objectives

Unit no.	Course learning outcomes	Teaching and learning activities	Assessment tasks
1.	• Understand the scope and significance of public health and hygiene. • Recognize the role of public health in promoting community wellbeing.	• Explain the relationship between nutrition and health. Scope of Public Health and Hygiene	• Multiple choice questions, quiz, Class test and students' presentation.
2.	• Understand the concept of environmental degradation. Identify factors contributing to environmental degradation.	• Describe the types of pollution, including air, water, land, and noise pollution. • Explain the associated health hazards and their effects on human health.	• Multiple choice questions, quiz, Class test and students' presentation.
3.	• Knowledge of Identify key preventive and control measures for communicable diseases.	• Describe the causes, symptoms, and preventive strategies for diseases like measles, malaria, hepatitis, cholera, filariasis, and HIV/AIDS.	• Multiple choice questions, match
4.	• Understand noncommunicable diseases (NCDs) and their risk factors.	• Describe genetic diseases, cancer, cardiovascular diseases, chronic respiratory diseases, diabetes, and epilepsy. • Explain the importance of early detection and management of NCDs.	• the following, students' presentation, quiz, class test focusing on short notes and definitions.
5.	• Learn about the World Health Organization (WHO) programs and their impact on global health. Explore the methods and channels for effective health education in India.	• Describe the basics of first aid for common health emergencies.	• Class tests, assignments, quiz, student presentations.

ABILITY ENHANCEMENT COURSE (AEC)

3HHLA101: Hindi Language (हिन्दी आधार पाठ्यक्रम, हिन्दी भाषा और संरचना)

(Credit: Theory -2 Tutorial - 0)

Scheme of Examination

Course Code	Course Name	Credit	Maximum marks Allotted						Duration of Exam.	
			Theory			Practical		Total	Theory	Practical
			End	Mid	Assign	End	Term Sem			
3HHLA101	Hindi Language (हिन्दी आधार पाठ्यक्रम, हिन्दी भाषा और संरचना)	2(2-0-0)	60	20	20	-	-	100	2 hr	-

पाठ्यक्रम के उद्देश्यः

- विद्यार्थियों में राष्ट्र प्रेम की भावना का विकास करना।
- हिन्दी के समृद्ध साहित्य को नयी पीढ़ी तक पहुँचाना ।
- पत्र–लेखन, सार लेखन, भाव पल्लवन एवं साक्षात्कार के कौशल का विकास करना।
- डायरी,संस्मरण, लेखन, पारिभाषिक, शब्दावली, तत्सम, तद्भव, देशज, विदेशी शब्दों इत्यादि के ज्ञानका परिमार्जन करना।

अपेक्षित परिणामः

- विद्यार्थी भारत भूमि से प्रेम व स्नेह के भावों को बढ़ा सकेगें।
- विद्यार्थियों की हिन्दी की भाब्द संपदा में वृद्धि होगी।
- पत्र–लेखन,सार लेखन, भाव पल्लवन साक्षात्कार के कौ ाल का विकास होगा।
- डायरी एवं संस्मरण लेखन विद्या का परिमार्जन होगा।
- हिन्दी के समृद्ध साहित्य को ा से लाभान्वित होगें।

पाठ्यक्रमः

इकाई – 1 भारत वंदना (काव्य) सूर्यकांत त्रिपाठी निराला, जाग तुझको दूर जाना सुश्री महादेवी वर्मा, स्वतंत्रता पुकारती (काव्य) जयशंकर प्रसाद, हम अनिकेतन (काव्य) बालकृष्ण शर्मा नवीन, भाषा की महत्ता और उसके विविध रूप, भाषा–कौशल

इकाई – 2 करूणा (निबंध) आचार्य रामचन्द्र शुक्ल, समन्वय की प्रक्रिया (निबंध) रामधारी सिंह 'दिनकर' बिच्छी बुआ (कहानी) डॉ. लक्ष्मण बिष्ट 'बटरोही', अनुवाद परिभाषा प्रकार, महत्व, विशेषताएं, हिन्दी की शब्द–संपदा, पारिभाषिक शब्दावली

इकाई – 3 विलायत पहुंच ही गया (आत्मकथांश) महात्मा गांधी, अफसर (व्यंग्य) शरद जो ी, तीर्थयात्री (कहानी) डॉ. मिथिलेष कुमार मिश्र, मकड़ी का जाला (व्यंग्य) डॉ. रामप्रकाश सक्सेना वाक्य– संरचना :तत्सम, तद्भव देशज विदेशी

इकाई – 4 अप्प दीपो भव (वक्तृत्व कला) स्वामी श्रद्धानंद, भारत का सामाजिक व्यक्तित्व (प्रस्तावना) जवाहरलाल नेहरू, पत्र मैसूर के महाराजा को (पत्र–लेखन) स्वामी विवेकानंद, बनी रहेंगी किताबें (आलेख) डॉ. सुनीता रानी घोष, पत्र–लेखनः महत्व और उसके विविध रूप, सड़क पर दौड़ते ईहा मगृ (निबंध) डॉ. श्यामसुन्दर दुबे

इकाई – 5 योग की शक्ति (डायरी) डॉ. हरिवं ा राय बच्चन, कोष के अखाड़े में कोई पहलवान नहीं उतरता (साक्षात्कार) – भाषाविद् डॉ– हरिदेव, बाहरी से प्रो. – त्रिभुवननाथ शुक्ल, नीग्रो सैनिक से भेंट (यात्री–संस्मरण) डॉ. देवेन्द्र सत्यार्थी, यदि ''बा'' न होती तो शायद गांधी को यह ऊँचाई न मिलती (साक्षात्कार) कथाकार– गिरिराज किशोर से सत्येन्द्र शर्मा सार –लेखन, भाव–पल्लवन साक्षात्कार और कौशल

संदर्भ पुस्तकः

कथा साहित्य आईसेक्ट ग्रुप प्रकाशन

पाठ्यक्रम सीखने के उद्देश्यों की प्राप्ती को सुगम बनाना

इकाई	पाठ्यक्रम के उद्देश्य	पाठ्यक्रम से प्राप्त लाभ	शिक्षण और सीखने की गतिविधियां	मूल्यांकन कार्य
1	• भाषा के विभिन्न रूपों का अध्ययन और जानकारी प्राप्त करना।	• भाषा के विभिन्न रूपों के साथ परिचित होना।	• भाषाओं के रूपों का प्रदर्शन और उनके विशेषताओं का अध्ययन करना। भाषाओं के रूपों का प्रदर्शन और उनके विशेषताओं का अध्ययन करना।	• भाषाओं के रूपों का प्रदर्शन और उनके विशेषताओं की व्याख्या करना।
2	• तत्सम और तद्भव शब्दों के अंतर को समझना।	• तत्सम और तद्भव शब्दों के बीच का अंतर समझना।	• तत्सम और तद्भव शब्दों के उदाहरण प्रदान करना और समझाना।	• तत्सम और तद्भव शब्दों के अंतर को समझाने के लिए उपाय करना।
3	• नाटक और गद्य साहित्य के बारे में जानकारी प्राप्त करना।	• नाटक और गद्य साहित्य के अध्ययन से साहित्यिक ज्ञान में वृद्धि होना।	• नाटक और गद्य साहित्य के उदाहरण और उनके विशेषताओं का अध्ययन करना।	• नाटक और गद्य साहित्य के उदाहरणों की व्याख्या करना।
4	• रस, अलंकार, दोहा, सोरठा आदि के बारे में जानकारी प्राप्त करना।	• साहित्यिक उपकरणों के ज्ञान से भाषा का सुधार होना।	• विभिन्न रसों, अलंकारों, दोहों, सोरठों इत्यादि के उदाहरण और व्याख्या करना।	• रस, अलंकार, दोहा, सोरठा आदि के उदाहरणों की व्याख्या करना।
5	• काव्यांग विवेचन, रस, छंद, अलंकार, उपमा, रूपक, दोहा, सोरठा, चौपाई आदि के बारे में जानकारी प्राप्त करना।	• साहित्यिक उपकरणों के ज्ञान से भाषा का सुधार होना।	• विभिन्न काव्यांग और साहित्यिक उपकरणों के उदाहरण और व्याख्या करना।	• काव्यांग और साहित्यिक उपकरणों के उदाहरणों की व्याख्या करना।

VALUE ADDED COURSE (VAC)

3SEEV106: Environmental Education

(Credit: Theory -3 Tutorial - 0)

Scheme of Examination

Course Code	Course Name	Credit	Maximum marks Allotted						Duration of Exam.	
			Theory			Practical		Total	Theory	Practical
			End Sem	Mid Sem	Assign	End Sem	Term Sem			
3SEEV106	Environmental Education	3(3+0)	60	20	20	-	-	100	3 hr	-

Course Objective

Upon completion of the course, the student – teacher will be able to:

- Understand the concept, significance, scope and terminologies objectives and program of environmental education.
- Develop awareness about the various types of pollution ecological Imbalances and life and contributions of environmental activities.
- Interpret the environmental legislations in conservation and protection of the environment.
- Understand the role of governmental and non-governmental Agencies in environmental education.
- Apply the methods of teaching and evaluation in environmental education.

Course Outcomes

- Environmental education raises awareness about various environmental issues, such as pollution, climate change, habitat destruction, and resource depletion.
- It provides individuals with a deeper understanding of ecosystems, biodiversity, and the interconnections between living organisms and their environment.
- Environmental education can lead to changes in behavior, such as reducing waste, conserving energy and water, and adopting sustainable consumption patterns.
- Individuals become more inclined to take care of their surroundings, leading to increased community involvement in local environmental projects.
- It fosters critical thinking skills by encouraging individuals to analyze complex environmental problems and develop solutions.

Syllabus:

Unit 1: Introduction to Environmental Education-

Environmental Education Concept, Importance and Scope, Objectives and Principles of Environmental Education. Basic Concepts in Environmental Education, Ecology, Eco-System, Food Chain, Natural Resources, Greenhouse Effect, Bio-Diversity.

Unit 2: Environment and Pollution-

Definition and Types of Environmental pollution, Air Pollution- Definition, Causes and Remedial Measures, Water Pollution: Definition, Causes and Remedial Measures, Soil Pollution: Definition, Causes and Remedial Measures, Sound Pollution: Definition, Causes and Remedial Measures, Ecological Imbalances -Deforestation, Soil Erosion.

Unit 3: Environmental Laws and Organization-

The Air Prevention and Control of Pollution Act 1977, The Water Prevention and Control of Pollution Act1974, Forest Conservation Act 1980, Environment Protection Act 1986, United Nations Environment Program (UNEP), International Union for Conservation of Nature and Natural Resources (IUCN), Central pollution control board (CPCB).

Unit 4: Environmental Ethics-

Role of Indian and other religions and cultures in environmental conservation. Green Politics, Earth Hour, Green Option Technologies, Environmental communication and public awareness, EIA Formulations, stages, Merits and demerits.

Unit 5: Methods of Teaching Environmental Education-

Project Work, Intellectual Meets-Seminars, Symposia, Workshops, Conferences, Group Discussions, Debates, Brain Storming Quiz, Poster Making, Models Making and Exhibitions.

Text Book

- Environmental science by Kamal Kant Joshi & Deepak Kumar, TechSar. 2019.
- Basics of Environmental science by Abhijit Mitra & Tanmay Ray Chaudhuri, New central book agency Pvt. Ltd. 2017.
- Essentials of Environmental Education by A.B. Saxena & V.V. Anand, Motilal Banarsidass publishing House, 2012.
- Environmental Studies by Dr. SM Saxena, Dr. Seema Mohan.

Reference Books

- Ecological Literacy: Educating Our Children for a Sustainable World, Michael K. Stone and Zenobia Barlow, Publication: Published by Sierra Club Books in 2005.
- Place-Based Education: Connecting Classrooms and Communities, David Sobel Publication: Published by The Orion Society in 2005.
- The Handbook of Environmental Education, Robert B. Stevenson, Michael Brody, Justin Dillon, and Arjen E.J. Wals, Publication: Published by Routledge in 2019.

Facilitating the Achievement of Course Learning Objectives

Unit no.	Course Learning Outcomes	Teaching and LearningActivities	Assessment Tasks
1	● The students about this particular are intended to gain knowledge about the objectives and importance of environmental education. Enabling them to understand the composition of environment, greenhouse effect. Students will improve their understanding towards the factors governing the life on earth	● Lectures ● Group discussion ● Sight Seeing ● The teaching will be done through lectures and group discussion	● Assignment ● Homework
2	● Students will understand about the impacts of our unusual and destructive use of resources and their harmful effects. ● Students will understand about the destruction of environment and its sustainability. Enhance the concern about this depletion among the students.	● Lectures ● Group discussion ● Visit to any industry or manufacturing site ● The teaching will be done through lectures and group discussion.	● Assignment ● Poster making

Unit no.	Course Learning Outcomes	Teaching and LearningActivities	Assessment Tasks
3	● Importance of government laws and agencies their interference to regulate pollution and harming the quality of environment. Methods to improve the quality of habitat and natural resources will be necessary for the students to have its knowledge and concern.	● Lectures ● Group discussion ● Visit to any law governing body ● The teaching will be done ● through lectures and group discussion	● Brain storming Quiz ● Assignment
4	● Students will know their ethics and responsibilities towards the improvement in quality of environment. Innovation, technologies, awareness through communication and various others measures through which a student can involve these practices in their lifestyle.	● Lectures ● Group discussion Sight Seeing ● The teaching will be done through lectures and group discussion	● Seminar ● Conferences
5	● The students will enhance the techniques to prepare a project on any of the issues regarding the environment pollution or the remedial measures. Students will find ways to present the issues through seminars, workshops, poster making, model making.	● Lectures ● Group discussion ● Seminars ● Poster making ● Model making	● Power point presentation Project work ● Debates ● Brain storming Quiz

VALUE ADDED COURSE (VAC)

3IFAV106: Fundamentals of AI

(Credit: Theory -3 Tutorial - 0)

Scheme of Examination

Course Code	Course Name	Credit	Maximum marks Allotted						Duration of Exam.	
			Theory			Practical		Total	Theory	Practical
			End Sem	Mid Sem	Assign	End Sem	Term Sem			
3IFAV106	Fundamentals of AI	(3-0-0)	60	20	20	-	-	100	3 hr	-

Course Objective

Student will be able-

- To understanding the importance of AI and puzzle problem.
- To understanding the Search Techniques.
- To understanding the Symbolic and Statistical Reasoning.
- To understanding the frames and Structural Knowledge Representation.
- To understanding the expert system life cycle.

Course Outcomes

Upon completion of the course, students will be able to:

- Understand the fundamental concepts and scope of Artificial Intelligence.
- Describe the essential tools and techniques used in Machine Learning.
- Describe interface mechanisms and their role in knowledge representation.
- Understand the fundamentals of probability theory and its role in AI.

Syllabus:

Theory:

Unit 1: Introduction: Artificial Intelligence, AI Problems, AI Techniques, The Level of the Model, Criteria for Success. Defining the Problem as a State Space Search, Problem Characteristics, Production Systems, Search: Issues in The Design of Search Programs, Un-Informed Search, BFS, DFS; Heuristic Search Techniques: Generate-And- Test, Hill Climbing, Best-First Search, A*Algorithm, Problem Reduction, AO*Algorithm, Constraint Satisfaction, Means-Ends Analysis.

Unit 2: Introduction to Machine Learning: Applications of ML, Difference between Data Mining and Predictive Analysis, Tools and Techniques of Machine Learning. What is Machine Learning, Basic Terminologies of Machine Learning

Unit 3: Knowledge Representations First order predicate calculus, Skolemization, resolution principle and unification, interface mechanisms, horn's clauses, semantic networks, frame systems and value inheritance, scripts, conceptual dependency.

Unit 4: Natural Language processing Parsing techniques, context free grammar, recursive transitions nets (RNT), augmented transition nets (ATN), case and logic grammars, semantic analysis. Game playing Minimax search procedure, alpha-beta cut offs, additional refinements. Planning Overview an example domain the block word, component of planning systems, goal stack planning, nonlinear planning.

Unit 5: Probabilistic Reasoning and Uncertainty Probability theory, bayes theorem and Bayesian networks, certainty factor. Expert Systems Introduction to expert system and application of expert systems, various expert system shells, vidwan frame work, Knowledge acquisition, case studies, MYCIN. Learning Rote learning, learning by induction, explanation-based learning

Reference Books

- Elaine Rich and Kevin Knight, "Artificial Intelligence," Tata McGraw-Hill. "Artificial Intelligence," 4th Edition, Pearson.
- Dan W. Patterson, "Introduction to Artificial Intelligence and Expert Systems," Prentice India.
- Nils J. Nilson, "Principles of Artificial Intelligence," Narosa Publishing House. Clocksin and C.S. Melish, "Programming in PROLOG," Narosa Publishing House.
- M. Sasikumar, S. Raman, etc., "Rule-based Expert System," Narosa Publishing House.

Facilitating the Achievement of Course Learning Objectives

Unit no.	Course learning outcomes	Teaching and learning activities	Assessment tasks
1	• Understand the fundamentals of Artificial Intelligence (AI). Identify AI problems and techniques. Learn about the levels of AI models and criteria for success. Explore state space search and production systems. Understand search algorithms such as BFS, DFS, and heuristic search techniques. Learn about problem reduction and constraint satisfaction. Familiarize with means ends analysis.	• Problem solving exercises on state space search. Group discussions on production systems and search algorithms. Handson exercises with BFS, DFS, and heuristic search algorithms. Case studies on problem reduction and constraint satisfaction. Practical demonstrations of means end analysis.	• Quizzes on AI fundamentals and problem-solving techniques. Written assignments on state space search. Group presentation on search algorithms.
2	• Learn about applications of Machine Learning (ML). Differentiate between Data Mining and Predictive Analysis. Explore tools and techniques of Machine Learning. Understand basic ML terminologies.	• Lectures on ML applications and differences from Data Mining. Discussions on ML tools and techniques. Handson experience with ML terminology. Case studies on real world ML applications.	• Written assignments on ML applications and differences from Data Mining. Quizzes on ML tools and terminology. Case study analysis of ML applications. Final examination on unit II content.
3	• Understand knowledge representations in AI. Learn about first order predicate calculus, Skolemization, and resolution principles. Explore interface mechanisms, horn's clauses, semantic networks, frame systems, and value inheritance. Familiarize with scripts and conceptual dependency.	• Practical exercises on resolution principles and interface mechanisms. Group discussions on semantic networks, frame systems, and scripts. Handson sessions with conceptual dependency. Case studies on real world knowledge representation systems.	• Problem solving assignments on predicate calculus and resolution. Quizzes on knowledge representation techniques.
4	• Explore Natural Language Processing (NLP) techniques. Learn about parsing techniques, context free grammar, and semantic analysis. Understand gameplaying strategies and Minimax search procedures. Familiarize with	• Lectures on NLP, parsing techniques, and semantic analysis. Coding practice for parsing and grammar. Problem solving exercises on gameplaying strategies. Practical demonstrations of	• Implementation and testing of parsing and semantic analysis. Problem solving assignments on game playing and planning. Quizzes on NLP and gameplaying

Unit no.	Course learning outcomes	Teaching and learning activities	Assessment tasks
	alpha beta cutoffs and planning components. Apply these concepts to an example domain.	planning components. Handson sessions with an example domain.	concepts. GD, Unit Test and Quizzes.
5	• Understand probabilistic reasoning and uncertainty in AI. Learn about probability theory, Bayes' theorem, and Bayesian networks. Explore certainty factors and expert systems. Familiarize with expert system shells, knowledge acquisition, and case studies. Learn about various learning techniques, including rote learning, induction, and explanation-based learning.	• Bayesian networks, and expert systems. Practical exercises on probability theory and Bayes' theorem. Group discussions on expert systems and knowledge acquisition. Handson sessions with learning techniques. Case studies on expert systems and learning methods.	• Problem solving assignments on probability theory and expert systems. Quizzes on probabilistic reasoning and learning techniques. Group presentation on expert system case studies.

BACHLOR OF SCIENCE

(Microbiology)

(B. Sc. (Microbiology) – CKUG04C03)

II Semester

MAJOR CORE COURSE

3SBIC203: Microbiology- II (Biotechnology and Immunology)

(Credits: Theory-4 Practical-2)

Scheme of Examination

Course Code	Course Name	Credits	Maximum Marks Allotted						Duration of exam	
			Theory			Practical		Total	Theory	Practical
			End Sem	Mid Sem	Assign	End Sem	Term Sem			
3SBIC203	Microbiology -II (Biotechnology and Immunol-ogy)	6(4-0-2)	60	20	20	60	40	200	3hr	2hrs

Course Objective

- Biotechnology is the study to understand the molecular basis of life and its role in the disease process.
- Immunology is the study of body defends itself against disease and helps us understand how the immune system is tricked into attacking its own tissue.
- Students will acquire proficiency in the concepts of aerobic respiration, anaerobic respiration, and fermentation, as well as the central metabolic pathways including the EMP pathway, ED pathway, PP pathway, and TCA cycle.
- They will also understand the components of the respiratory chain, oxidative phosphorylation, and ATP synthesis.

Course Outcomes

- Biotechnology is a specialized application of chemistry to biological samples. Immunology is the study of a patient's immune system.
- Immunology testing is less automated than Biotechnology and results usually take about a week before they are available.
- Comprehend the general concepts of metabolism, including anabolism, catabolism, and amphiboles.
- Understand the cells and organs of the immune system, as well as the basics of antigenicity, antibody structure and function, and antigen-antibody reactions.

Syllabus Credits 6(4-0-2)

UNIT - I

Structure and properties of mono and disaccharides, amino acids and peptides, bases; purines and pyrimidines, sugars; ribose, deoxyribose and nucleoside and nucleotide; general account of lipids. concept of macromolecules; Structural and functional organization of polysaccharides (starch, glycogen, cellulose, mucopolysaccharides), proteins.

UNIT - II

Microbial Energetics Concept of aerobic respiration, anaerobic respiration, and fermentation. Central metabolic pathways: EMP pathway, ED pathway, PP pathway, and TCA cycle. Components of respiratory chain, and their inhibitors. Oxidative phosphorylation: ATP synthesis and ATP synthase. Uncouplers, inhibitors and ionophores. Chemical coupling, conformational coupling and chemiosmotic hypothesis.

UNIT - I

Enzymes; historical account, classification, Co-enzymes and their role. Enzyme action, Enzyme kinetic. Km and Enzyme inhibition. Allosteric Enzymes and isoenzymes. Extracellular enzymes and their role.

UNIT – IV

Metabolism; General concept of metabolisms (anabolism, catabolism, and amphiboles). Glycolysis TCA Cycle and HMP Shunt. Anaerobic catabolism of glucose; alpha, beta and gamma oxidation of fatty acids.

UNIT – V Concept of immunity, innate and acquired immunity. Brief account of cells and organs of immune system. Antigen and Antigenicity. Antibody structure and function. Antigen- Antibody reaction.

Practical (2 Credit)

- General and specific qualitative test tor carbohydrates
- General and specific qualitative test for amino acids
- General and specific qualitative test for lipids
- Estimation of Protein
- Estimation of blood glucose
- Assay of the activity of amylases
- Identification and Enumeration of White Blood Cells
- Identification of human blood groups.
- To perform Total Leukocyte, Count of the given blood sample.

Textbook

- A Text Book of Microbiology by D. K. Maheshwari.
- Microbiology book by – Michael J. Pelzer and L.C.S. chain.
- A text book of microbiology by Anantha Narayan and paniker's.

Reference Book

1. Biochemistry by Lubert Stryer, Jeremy M. Berg, and John L. Tymoczko - Published by W. H. Freeman and Company.

2. Microbial Physiology by Albert G. Moat, John W. Foster, and Michael P. Spector - Published by Wiley-Liss.

3. Lehninger Principles of Biochemistry by David L. Nelson and Michael M. Cox - Published by W. H. Freeman and Company.

4. Enzymes: Biochemistry, Biotechnology, Clinical Chemistry by Trevor Palmer - Published by Horwood Publishing.

5. Immunobiology: The Immune System in Health and Disease by Charles A. Janeway Jr., Paul Travers, Mark Walport, and Mark J. Shlomchik - Published by Garland Science.

Facilitating the achievement of course learning objectives

Unit No.	Course learning outcomes	Teaching and learning activities	Assessment tasks
1.	Students should be aware of the concept of Structure and properties of mono and disaccharides, amino acids and peptides.	Theory class focusing on discussion about the different type of sugar and starch.	Multiple choice questions, quiz, Class test and students' presentation.
2.	Understand the structures and functions of common polysaccharides, including starch (energy storage in plants), glycogen (energy storage in animals), cellulose (structural component in	Students should grasp them remarkable knowledge of the structure and functions of proteins, including primary, secondary, tertiary, and quaternary structures.	Multiple choice questions, quiz, Class test and students' presentation.

Unit No.	Course learning outcomes	Teaching and learning activities	Assessment tasks
	plant cell walls), and mucopolysaccharides (important in connective tissues).		
3.	Explore the historical development of enzymology, classify enzymes based on their functions, and appreciate the diversity and specificity of enzymes in catalyzing biochemical reactions. Learn about the concepts of Km (Michaelis-Menten constant) and Vmax (maximum velocity) in enzyme kinetics.	structures and discussion on the of enzyme inhibition (competitive, non-competitive, and mixed) and their effects on enzyme activity.	Multiple choice questions, match
4.	Explore the biochemical pathways of glycolysis (glucose breakdown), the tricarboxylic acid (TCA) cycle (citric acid cycle or Krebs cycle), and understand the anaerobic catabolism of glucose (e.g., fermentation), as well as the processes of alpha, beta, and gamma oxidation of fatty acids in energy production and lipid metabolism.	Theory classes and discussion on the biochemical pathways of glycolysis cycle and catabolism process.	the following, students' presentation, quiz, class test focusing on short notes and definitions.
5.	Learners should Identify and understand the roles of immune system components and explore the structure of antibodies (immunoglobulins) and their roles in immune responses, including antigen recognition, neutralization, opsonization, and complement activation.	Theory classes and discussion on immune system components and Antibody Structure and Function.	Class tests, assignments, quiz, student presentations.

***Assessment tasks listed here are indicative and may vary.**

MINOR CORE COURSES

3SCBM204: Botany -II (Cell Biology and Genetic)
(Credits: Theory-2 Practical-2)

Scheme of Examination

Course Code	Course Name	Credits	Maximum Marks Allotted						Duration of exam	
			Theory			Practical				
			End Sem	Mid Sem	Assign	End Sem	Term Sem	Total	Theory	Practical
3SCBM204	Botany -II (Cell Biology and Genetic)	4(2-0-2)	60	20	20	60	40	200	3hr	2hrs

Course Objectives

- Outline the structure of the bio molecules found in all living organisms.
- Describe the function and structure of cells including the metabolic reactions that occur in cells.
- Explain the process of inheritance.
- Describe how RNA, DNA and proteins are synthesized.
- Explain the process of cell division in both somatic and germ cells.

Course Learning Outcome

- The course aims to develop students understanding of three areas of widely used and advanced scientific methods – spectroscopic tools, molecular imaging and bioinformatics.
- This is achieved via lectures, classes, seminars and a bioinformatics problem-based learning exercise.
- To help students develop successful strategies for learning how to learn and communicate complex information in cell biology, we developed a quarter-long cell biology class based on team projects.
- Each team researches a particular human disease and presents information about the cellular structure or process affected by the disease, the cellular and molecular biology of the disease, and recent research focused on understanding the cellular mechanisms of the disease process.

Syllabus Credits: 2-0-2

UNIT – I

The cell envelops and organelles: Techniques of cell biology Prokaryotic and Eukaryotic cell structure and plasma membrane lipid bilayer structure, function of the cell wall. Structure and function of cell organelles: Golgi bodies, ER, Peroxisome, Vacuole, Chloroplast and Mitochondrion. Cell signaling and cell receptors, signal transduction.

UNIT – II

Chromosomal Organization: Structure and function of chromosome centromere and telomere. Nucleosome model, Special types of chromosomes, Mitosis and Meiosis. Variation in chromosome Structure: Deletions, Duplication Translocations and Inversions. Variation in chromosome number, Euploidy, Aneuploidy, DNA: The genetic material, DNA Structure and replication,

UNIT – III

Genetic inheritance: Mendelism; Law of dominance, laws of segregation and independent assortment. Linkage analysis, Interactions of genes. Cytoplasmic inheritance, Mutations: spontaneous and induced, Transposable elements, DNA damage and repair.

UNIT – IV

Gene: Development of genetics structure of gene, gene verses alleles, genetic code, transfer of genetic information. Transcription, translation, protein synthesis, tRNA, and ribosomes. Regulation of gene expression in prokaryotes and eukaryotes. Organic evolution role of RNA and evolution.

UNIT – V

Plant Breeding: Introduction, Methods Selection and Hybridization (Pedigree, backcross, mass selection and bulk method)

Biotechnology: Definition; basic aspects of plant tissue culture; Cellular totipotency, Differentiation and morphogenesis important achievements of biotechnology in agriculture.

Genetic Engineering: Tools and techniques of recombinant DNA technology; Cloning vectors; biology of Agro bacterium; Vectors for gene delivery and marker genes, DNA fingerprinting genomic and cDNA library: Gene mapping and chromosome walking.

Biostatistics: Introduction and application.

Practical **Credits: 2**

- To examine the electron micrograph of a eukaryotic cell.
- To examine the electron micrograph of a chloroplast.
- To examine the electron micrograph of an endoplasmic reticulum.
- To examine the electron micrograph of a Golgi body.
- To examine the electron micrograph of a Ribosome.
- To examine the electron micrograph of a Nucleus.
- To make a temporary acetocarmine stained slides of root tip of onion and to study various stages of mitosis.
- To make a temporary acetocarmine stained slides of Floral bud of onion and to study various stages of meiosis.
- Cytological examination of chromosome.
- To demonstrate the independent assortment by various type of pea seeds.

Reference Book

- Vol. 1st and Vol. 2nd A Text Book of Botany Hai, Bhattachary, Ghosh.
- Vol. 1st and Vol. 2nd College Botany Gangulee and Kar.
- Genetics: Classical to modern –P.K. Gupta.
- Cell Biology and Genetics Molecular Biology- P.S. Verma 2001.
- Cell Biology and Genetics -Ralph Taggart 1992.

Text Book

- A Text Book of Cell Biology and Genetics -Dr Veer Bala Rastogi.
- S.B Agrawal, V.K Agrawal and Amit Agrawal Unified Vanaspati Vigyan.
- A Text Book of Cell Biology Genetics and Evaluation-Surya Prakash Mishra.

Facilitating the achievement of course learning objectives

Unit No.	Course Learning Outcome	Teaching and Learning Activities	Assessment Tasks
1	Students should be able to explain the mechanisms of passive and active transport across the cell membrane, including diffusion, osmosis, facilitated diffusion, and active transport processes.	Practical sessions using microscopes can be highly effective. Provide students with microscope slides containing stained bacterial cells and ask them to	Class test focusing and short questions.

Unit No.	Course Learning Outcome	Teaching and Learning Activities	Assessment Tasks
		observe and identify cell envelopes under different magnifications.	
2	Students should be able to describe the central role of the nucleus in controlling gene expression and maintaining genetic information. Students should understand the processes of DNA replication, transcription, and mRNA processing that occur within the nucleus.	If physical lab resources are limited, consider using virtual labs that allow students to virtually manipulate and experiment with cellular structures. Some online platforms offer simulations specifically focused on cell biology.	Class test focusing on definitions and short questions.
3	Students should understand the underlying molecular processes that lead to chromosome structural changes, such as unequal crossing over, non-disjunction, and chromosomal breakage and repair.	start with a brief lecture explaining the basic concepts of chromosomes and their structure. Engage students in a discussion about the importance of chromosome structure in inheritance and variation.	Class test focusing on definitions and short and questions.
4	Students should have a deep understanding of Mendelian inheritance patterns, including dominant and recessive traits, Punnett squares, and the principles of segregation and independent assortment.	Introduce Punnett squares to help students understand how genes are inherited and the probability of certain traits appearing in offspring. Provide practice problems for them to solve.	Class test focusing on and short questions.
5	Students should be able to describe non-Mendelian inheritance patterns such as incomplete dominance, codominance, and multiple alleles and understand how these patterns deviate from Mendelian genetics.	Assign students a genetic disorder (e.g., sickle cell anaemia, Huntington's disease) and have them create informative presentations or posters. They can explain the genetic basis of the disorder, its symptoms, and its inheritance patterns.	Class test focusing on and short questions.

MINOR CORE COURSES

3SPCM204: Chemistry-II (Physical Chemistry)

(Credits: Theory-2 Practical-2)

Scheme of Examination

Course Code	Course Name	Credits	Maximum Marks Allotted						Duration of exam	
			Theory			Practical				
			End Sem	Mid Sem	Assign	End Sem	Term Sem	Total	Theory	Practical
3SPCM204	Chemistry-II (Physical Chemistry)	4(2-0-2)	60	20	20	60	40	200	3 hr	2 hr

Course Objectives

- Understanding reaction rates and factors influencing them.
- Grasping atomic properties and periodic trends.
- Exploring bonding theories and molecular shapes.
- Analyzing properties and reactions of alkanes, cycloalkanes, and alkenes.
- Understanding key reactions and synthesis pathways.

Course Learning Outcomes

- Ability to analyze reaction rates and factors affecting them.
- Understanding atomic properties and periodic trends.
- Proficiency in bonding theories and molecular shapes.
- Mastery of properties and reactions of specific organic compounds.
- Competence in understanding and predicting key organic reactions.

Syllabus Credits 2-0-2

Physical Chemistry

UNIT – I

Chemical Kinetics

Chemical kinetics and its scope, rate of a reaction, factors influencing the rate of a reaction- concentration, temperature, pressure, solvent, light and catalyst. Concentration dependence of rates, mathematical characteristics of simple chemical reactions- zero order, first order, second order, pseudo-order, half-life and mean life. Determination of the order of reaction, differential method, method of integration, method of half-life period and isolation method. Effect of temperature on rate of reaction, Arrhenius equation, concept of activation energy.

Inorganic Chemistry

UNIT – II

Atomic Structure

Idea of de Broglie's matter waves, Heisenberg uncertainty principle, atomic orbitals, Schrödinger wave equation, significance of φ , quantum numbers, radial and angular wave functions and probability distribution curves, effective nuclear charge.

UNIT – III

Chemical Bonding

Covalent Bond: Valence bond theory and its limitations, directional characteristic of covalent bond, various type of hybridization and shapes of simple inorganic molecules and ions. Valence Shell Electron Pair Repulsion (VSEPR) theory to NH_3, SF_4, ClF_3, and H_2O. Molecular Orbital theory for homonuclear and heteronuclear (CO and NO) diatomic molecules, multicenter bonding in electron deficient molecules, bond strength and the bond energy, percentage ionic character of covalent bond.

Organic Chemistry

UNIT – IV

Alkanes and Cycloalkanes

IUPAC nomenclature of alkanes, classification, isomerism in alkanes, sources and methods of preparation, physical properties and chemical reactions of alkanes, mechanism of free radical halogenation of alkanes.

Cycloalkanes

Nomenclature, methods of preparations, chemical reactions. Baeyer's strain theory and its limitations, ring strain in cyclopropane and cyclobutene, theory of strain less rings.

UNIT – V

Cycloalkenes, Dienes, Alkenes

Methods of formation, conformation and chemical reactions of cycloalkenes. Nomenclature and classification of dienes: isolated, conjugated and cumulated dienes. Structure of allenes and butadiene, methods of formation, polymerization. Chemical reactions - 1,2 and 1,4 additions, Diels-Alder reaction. Nomenclature, structure and bonding in alkenes. Methods of formation. Chemical reactions of alkenes- electrophilic and free radical addition. hydroboration oxidation and polymerization of alkenes.

Practical Content **Credits :2**

Physical Chemistry

- Determination of boiling point.
- Preparation of solutions of various concentrations, NaOH, HCl, H2SO4.

Inorganic Chemistry

- Inorganic mixture analysis.
- Macro/Semi-micro-Analysis- Cation analysis, separation and identification of ions from group I-VI, anion analysis.

Organic Chemistry

- Detection of elements (N, S and Halogens) 2 elements.
- Functional groups (phenolic, carboxylic, carbohydrates, amines, and aniline) in simple organic compounds.

Text Books

- Unified Chemistry by Tandon, Rathore and Agarwal.
- Chemical Kinetics by Keith J. Laidler and John H. Meiser.
- Principles of Physical Chemistry by Peter Atkins and Julio de Paula.
- Inorganic Chemistry by Gary L. Miessler and Paul J. Fischer.
- Organic Chemistry by Jonathan Clayden, Nick Greeves, and Stuart Warren.
- Fundamentals of Molecular Spectroscopy by C.N. Banwell

Reference Books

- Chemical Kinetics and Reaction Dynamics by Paul L. Houston.
- Advanced Inorganic Chemistry by F. Albert Cotton and Geoffrey Wilkinson.
- Organic Chemistry by Francis A. Carey and Richard J. Sundberg.
- Physical Chemistry by Robert J. Silbey, Robert A. Alberty, and Moungi G. Bawendi.
- Organic Reaction Mechanisms by V.K. Ahluwalia.

Facilitating the achievement of course learning objectives

Unit No.	Course Learning Outcome	Teaching and Learning Activities	Assessment Tasks
1	Understand chemical kinetics and its scope, including factors affecting reaction rates. Analyse the mathematical characteristics of simple chemical reactions and methods to determine reaction orders.	Organize a scavenger hunt where students explore the periodic table to locate and identify s-block elements. This activity helps familiarize them with the elements in this block.	Quiz assessing understanding of chemical kinetics and factors affecting reaction rates.
2	Describe the historical development of atomic models from Dalton's to the modern quantum mechanical model. Explain the limitations and strengths of each atomic model.	Organize a timeline activity where students create a visual representation of the historical development of atomic models, starting from Dalton's model to the modern quantum mechanical model.	Written exam on periodic properties and trends.
3	Define ionic bonding and explain how it differs from covalent bonding. Describe the transfer of electrons between atoms to form ions in ionic compounds.	Provide students with model kits or digital simulations to build and visualize the crystal lattice structures of common ionic compounds.	Presentation on the comparison between Valence Bond and Molecular Orbital theories.
4	Understand and apply Huckell's rule to determine whether a compound is aromatic, antiaromatic, or non-aromatic based on its number of electrons.	Assign research projects where students investigate the environmental impact of polycyclic aromatic hydrocarbons (PAHs) and their relevance in air pollution and carcinogenicity.	Class quizzes or short tests that assess your understanding of specific lecture topics.
5	Describe the general methods for the halogenation of organic compounds, including free-radical halogenation, electrophilic halogenation, and nucleophilic halogenation.	Conduct laboratory experiments where students synthesize alkyl and aryl halides using various methods such as halogenation reactions or substitution reactions. Emphasize safety protocols.	Homework assignments on alkynes and alkyl halides.

INTER DISCIPLINARY COURSE

3SATI202: Analytical Techniques

(Credits: Theory-3 Practical-0)

Scheme of Examination

Course Code	Course Name	Credit	Maximum marks Allotted						Duration of Exam.	
			Theory			Practical		Total	Theory	Practical
			End Sem	Mid Sem	Assign	End Sem	Term Sem			
3SATI202	Analytical Techniques	3(3-0-0)	60	20	20	-	-	100	3hr	-

Course Objective

- Gain a comprehensive understanding of various analytical techniques used in scientific research, industry, or specific fields such as chemistry, biology, environmental science, or materials science.
- Develop skills in collecting, processing, and interpreting analytical data. Emphasize the importance of accuracy, precision, and reliability in analytical measurements.
- Explore qualitative analysis methods, including the identification of unknown substances and the interpretation of spectra or chromatograms.
- Stay updated on the latest developments in analytical techniques and technologies. Explore emerging trends in the field and their potential applications.

Course Learning Outcomes

- Students will be able to apply a variety of analytical techniques to solve scientific problems in their respective fields.
- Students will demonstrate the ability to operate and troubleshoot common analytical instruments with precision and accuracy.
- Students will implement and adhere to quality assurance and quality control practices to ensure the reliability and validity of analytical results.
- Students will adhere to laboratory safety protocols, recognizing and mitigating potential hazards associated with analytical techniques.

Syllabus: **Credits: 3(3-0-0)**

Unit 1: Introduction to Analytical Techniques

Chemical Measurements and Analytical tools, Experimental Error, Statistics and Quality Assurance, Chemical Equilibrium, Sample Preparation, Importance of analytical techniques in various fields, Classification of analytical methods

Unit 2: Spectroscopic Techniques

Introduction to spectroscopy, UV Visible Spectroscopy and applications, Infrared Spectroscopy (IR) and applications, Nuclear Magnetic Resonance Spectroscopy (NMR) and applications, Mass Spectrometry (MS) applications

Unit 3: Chromatographic Techniques

Introduction to chromatography (Principle, Instrumentation, working and Application), Gas Chromatography (Principle, Instrumentation, working and Application), Liquid Chromatography (Principle, Instrumentation, working and Application), High-performance Liquid Chromatography (Principle, Instrumentation, working and Application), Thin Layer Chromatography (Principle, Instrumentation, working and Application)

Unit 4: Electrochemical Techniques

Introduction to electrochemistry, Potentiometry (Principle, theory and types) Voltammetry (Principle, Instrumentation, working and Application), Conductometry (Principle, Instrumentation, working and Application), Applications in environmental analysis

Unit 5: Microscopy and Imaging Techniques

Introduction to microscopy, Optical microscopy, Electron microscopy (SEM and TEM), Scanning Probe Microscopy (SPM), Imaging techniques in biological and materials analysis, Applications and advancements.

Text Book

- Quantitative Chemical Analysis" by Daniel C. Harris.
- Principles of Instrumental Analysis" by Douglas A. Skoog, F. James Holler, and Stanley R. Crouch.
- Fundamentals of Analytical Chemistry" by Douglas A. Skoog, Donald M. West, and F. James Holler
- Instrumental Methods of Analysis" by Willard, Merritt, Dean, and Settle.

Reference Books

- Handbook of Analytical Techniques" by D. A. Skoog, D. M. West, F. J. Holler, and S. R. Crouch.
- Analytical Chemistry: A Modern Approach to Analytical Science" by Robert Kellner, JeanMichel Mermet, Matthias Otto, and Miguel Valcárcel.
- Comprehensive Analytical Chemistry" Series.
- Modern Methods of Chemical Analysis" by Arthur I. Vogel.

Facilitating the achievement of course learning objectives

Unit no.	Course learning outcome	Teaching and learning activities	Assessment tasks
1	• Students will understand the principles of chemical measurements and demonstrate proficiency in using various analytical tools.	• Organize discussions on the principles behind the classification of analytical methods. • Students work in groups to categorize and present different analytical methods, highlighting their principles and applications.	• Presentation, Exam and quiz
2	• Understand the principles and techniques of various spectroscopic methods.	• Provide an overview of spectroscopy, its principles, and the different types.	• Presentation, Exam and quiz
3	• Understand various chromatographic techniques, emphasizing the importance of understanding molecular interactions and their impact on separation.	• Provide lectures and interactive workshops.	• Presentation, Exam and quiz
4	• Provides students with a foundational understanding of the principles governing the interaction between chemical systems and electricity	• Introduce students to the basic principles of electrochemistry and its significance in chemical analysis.	• Presentation, Exam and quiz

Unit no.	Course learning outcome	Teaching and learning activities	Assessment tasks
5	• Providing students with a comprehensive introduction to the principles and techniques of microscopy. It covers the fundamental concepts behind microscopy, highlighting its pivotal role in observing and analysing structures at various scales.	• Theoretical lectures cover the basics of microscopy, including historical developments and key concepts	• Presentation, Exam and quiz

ABILITY ENHANCEMENT COURSE

3HELA201: English Language

(Credit: Theory -2 Tutorial - 0)

Scheme of Examination

Course Code	Course Name	Credit	Maximum marks Allotted						Duration of Exam.	
			Theory			Practical		Total	Theory	Practical
			End Sem	Mid Sem	Assign	End Sem	Term Sem			
3HELA201	English Language	2(2+0)	60	20	20	-	-	100	2 hr	-

Course Objective

- To Study the basic concept and Language Skills of English Language.
- Comprehensive study of different kinds of vocabulary in English Language
- To Study the different era in every story and moos in poems.

Course Outcomes

- Students will be able to understand the basic concept and Language Skills of English Language.
- Students will be able to understand the different use of vocabulary in their sentences.
- Students will be able to understand the varieties of stories on different issues and on different format.

Syllabus:

Unit 1:

- Amalkanti: Nirendranth Chakrabarti
- Sita: Toru Dutt
- Preface to the Mahabharata: C. Rajagopalachari
- Satyagraha: M.K. Gandhi
- Toasted English: R.K. Narayan
- The Portrait of a lady: Khushwant Singh

Unit 2: Comprehension (unseen passages, summary, note making)

Unit 3: Composition and Paragraph Writing (Based on expansion of an idea)

Unit 4: Basic Language Skills: Vocabulary – Synonyms, Antonyms, Word Formation. Prefixes and Suffixes, Words likely to be confused and Misused, Words similar in Meaning or Form, Distinction between Similar Expressions, Speech Skill.

Unit 5: Basic Language Skills: Grammar and usage – The Tense Forms, Propositions, Determiners and Countable/Un-countable Nouns, Verb, Articles Adverbs.

Reference Books

- English language & Indian Culture – Dr. Pankaj Kumar Singh, Dr. Ashwin Joshi - Thakur Publication, Bhopal.
- Indian Art & Culture – Dr. Manish Rannian (IAS) – Prabhat Prakashn
- Indian Culture & Heritage – Romila Thapar – Kindle Unlimited

Facilitating the Achievement of Course Learning Objectives

Unit	Learning Outcome	Teaching-Learning Activities	Assessment Tasks
1	● Understand the historical context of English in India and its impact on Indian culture.	● Lecture on the history of English in India. ● Group discussions on the cultural influences of English. ● Readings and analysis of relevant texts.	● Research paper on the historical development of English in India. ● Group presentation on cultural assimilation.
2	● Analyze the influence of literature in English on Indian culture and identity.	● Close reading of select literary works by Indian authors writing in English. ● Comparative analysis of Indian and Western literary traditions. ● Guest lectures by Indian authors.	● Essay on the impact of Indian English literature on cultural identity. ● In-class quizzes on literary analysis.
3	● Explore the role of English in contemporary Indian society and media.	● Case studies on the use of English in Indian media. ● Group projects on language in advertising. ● Guest speakers from the media industry.	● Media analysis report on the use of English in Indian news outlets. ● Group presentation on language in advertising campaigns.
4	● Investigate the intersection of English and Indian languages and their cultural significance.	● Language workshops on common Indian languages and their influence on English. ● Interviews with bilingual/multilingual individuals. ● Analysis of code-switching in communication.	● Research paper on language convergence and divergence in bilingualism. ● Oral presentations on code-switching in real-life contexts.
5	● Reflect on the challenges and opportunities of bilingualism and multiculturalism in India.	● Group discussions on identity and language choices. ● Debates on language policy and diversity in India. ● Field visits to multilingual communities.	● Final reflective essay on personal experiences and insights regarding bilingualism and multiculturalism in India. ● Participation in debates and discussions.

SKILL ENHANCEMENT COURSE

3SIPS205: Intellectual Property Right

(Credits: Theory-2 Practical-0)

Scheme of Examination

Course Code	Course Name	Credits	Maximum marks Allotted						Duration of Exam.	
			Theory			Practical		Total	Theory	Practical
			End Sem	Mid Sem	Assign.	End Sem	Term work			
3SIPS205	Intellectual Property Right	2(2-0)	60	20	20	-	-	100	2 hr	-

Course Objectives

- Introduce students to various forms of intellectual property, including copyrights, trademarks, patents, trade secrets, and industrial designs.
- Provide an overview of the differences between these types of IPR.
- Explore the national and international legal frameworks and treaties governing intellectual property rights.
- Examine the obligations and protections under these legal frameworks.
- Discuss the principles of copyright law, including the scope of protection, duration, and fair use.
- Explain how copyright applies to various forms of creative works, such as literature, music, and software.
- Provide an understanding of trademark law, including the registration process and enforcement of trademark rights.

Course Learning Outcomes

- Understand the foundational concepts of intellectual property, including its nature, significance, and historical development.
- Differentiate between various types of intellectual property rights, such as copyrights, trademarks, patents, trade secrets, and industrial designs.
- Explain the rights and protections afforded by intellectual property laws, including the scope and duration of protection.

Syllabus: Credits :200

Unit 1: Introduction to intellectual property right, Concept and kinds. Economic importance. IPR in India and world: Genesis and scope, some important examples. IPR and WTO (TRIPS, WIPO).

Unit 2: Patents objectives, Rights, Patent Act 1970 and its amendments. Procedure of obtaining patents, Working of patents. Infringement.

Unit 3: Copyrights Introduction, Works protected under copyright law, Rights, Transfer of Copyright, Infringement.

Unit 4: Trademarks Objectives, Types, Rights, Protection of goodwill, Infringement, Passing off, Defences, Domain name: Industrial Designs Objectives, Rights, Assignments, Infringements, Defences of Design Infringement

Unit 5: Protection of Traditional Knowledge Objective, Concept of Traditional Knowledge, Holders, Issues concerning, Bio Prospecting and Bio Piracy, Alternative ways, protect ability, Need for a Sui Generis regime, Traditional Knowledge on the International Arena, at WTO, at National level, Traditional Knowledge Digital Library.

Reference Books

- N.S. Gopalakrishnan and T.G. Agitha, (2009) Principles of Intellectual Property Eastern Book Company, Lucknow.
- Kerly's Law of Trade Marks and Trade Names (14th Edition) Thomson, Sweet and Maxweel.
- Ajit Parulekar and Sarita D' Souza, (2006) Indian Patents Law – Legal and Business Implications; Macmillan India Ltd.
- B.L. Wadehra (2000) Law Relating to Patents, Trade Marks, Copyright, Designs and Geographical Indications; Universal law Publishing Pvt. Ltd., India.
- P. Narayanan (2010) Law of Copyright and Industrial Designs; Eastern law House, Delhi.

Facilitating the achievement of course learning objectives

Unit no.	Course learning outcome	Teaching and learning activities	Assessment tasks
1	• Understand the concept and importance of IPR in various fields. • Identify different types of IPR and their applications. • Recognize the economic significance of IPR for individuals, businesses, and economies. • Understand the genesis, scope, and impact of IPR in India and globally. • Analyse real world examples of IPR in action. • Comprehend the role of TRIPS, WIPO, and WTO in shaping global IPR norms	• Copyright protects original literary, artistic, and musical works, such as books, music, paintings, and software. It grants the creator exclusive rights to reproduce, distribute, and display their work.	• Class text and short and long questions
2	• Students should understand the rights granted to patent holders, the objectives of the patent system (e.g., encouraging innovation and knowledge sharing), and the limitations of patent protection.	• Analyse historical and contemporary patent case studies to illustrate the importance and implications of patents. • Discuss landmark patent disputes to highlight the legal aspects of patent rights and infringement.	• Class text and short and long questions
3	• Students will acquire a fundamental understanding of what copyrights are, their purpose, and their significance in protecting creative works.	• Provide students with a scenario where they need to seek copyright clearance for a specific project, such as using copyrighted music in a film.	• Class text and short questions and definitions
4	• Students should be able to describe the primary objectives of trademarks, including their role in brand identification, consumer protection, and preventing unfair competition.	• Have students classify various trademarks into different types (e.g., word marks, design marks) based on provided examples.	• Class text and short and long questions

Unit no.	Course learning outcome	Teaching and learning activities	Assessment tasks
5	• The protection of GIs is recognized under international agreements like the Agreement on Trade Related Aspects of Intellectual Property Rights (TRIPS) administered by the World Trade Organization (WTO).	• Provide case studies of TK holders and instances of bioprospecting and biopiracy. Analyse these cases to understand the complexities and ethical dilemmas involved	• Class text and short questions and definitions

VALUE ADDED COURSE

3ICSV206 - Cyber Security

(Credit: Theory -3 Tutorial - 0)

Scheme of Examination

Course Code	Course Name	Credits	Maximum marks Allotted						Duration of Exam.	
			Theory			Practical		Total	Theory	Practical
			End Sem	Mid Sem	Assign.	End Sem	Term work			
3ICSV206	Cyber Security	3-0-0	60	20	20	-	-	100	3 hr	-

Course Objective

- Learn to analyze the security of in-built cryptosystems.
- Know the fundamental mathematical concepts related to
- security.
- Develop cryptographic algorithms for information security.
- Understand cybercrimes and cyber security.

Course Outcomes

Understand the fundamentals of networks security, security architecture, threats and vulnerabilities. Apply the different cryptographic operations of symmetric cryptographic algorithms. Apply the different cryptographic operations of public key cryptography. Apply the various Authentication schemes to simulate different applications. Understand various cyber-crimes and cyber security.

Syllabus:

Theory:

Unit 1: Introduction to Cyber Security Introduction,

Computer Security, Threats, Harm, Vulnerabilities, Controls, Authentication, Access Control and Cryptography. Web attack: Browser Attacks, Web Attacks Targeting Users, Obtaining User or Website Data, Email Attacks. Network Vulnerabilities: Overview of vulnerability scanning, Open, Port / Service Identification, Banner /Version Check, Traffic Probe, Vulnerability Probe, Vulnerability Examples, OpenVAS, Metasploit. Networks Vulnerability Scanning (Netcat, Socat), Network Sniffers and Injection tools.

Unit 2: Network Défense tools Firewalls and Packet Filters:

Firewall Basics, Packet Filter Vs Firewall, how a Firewall Protects a Network, Packet Characteristic to Filter, Stateless Vs Stateful Firewalls, Network Address Translation (NAT) and Port Forwarding. VPN: the basic of Virtual Private Networks. Firewall: Introduction, Linux Firewall, Windows Firewall. Snort: Introduction Detection System.

Unit 3: Web Application Tools Scanning for web vulnerabilities tools:

Nikto, W3af, HTTP utilities - Curl, OpenSSL and S-tunnel. Application Inspection tools – Zed Attack Proxy, Sql-map, DVWA, Web goat. Password Cracking and Brute-Force Tools: John the Ripper, L0htcrack, PW dump, HTC-Hydra.

Unit 4: Introduction to Cyber Crime, law and Investigation:

Cyber Crimes, Types of Cybercrime, Hacking, Attack vectors, Cyberspace and Criminal Behavior, Clarification of Terms, Traditional Problems Associated with Computer Crime, Introduction to Incident Response, Digital Forensics, Computer Language, Network Language, Realms of the Cyber world. Internet crime and Act: A Brief History of the Internet, Recognizing.

Unit 5: Defining Computer Crime, Contemporary Crimes, Computers as Targets, Contaminants and Destruction of Data, Indian IT ACT Page 3 of 23 2000. Firewalls and Packet Filters, password Cracking, Keyloggers and Spyware, Virus and Warms, Trojan and backdoors, Steganography, DOS and DDOS attack, SQL injection, Buffer Overflow, Attack on wireless Networks.

Reference Books

- Behrouz A. Ferouzan, Deb deep Mukhopadhyay, "Cryptography and Network Security", 3rd Edition, Tata McGraw Hill, 2015.
- Charles Pfleeger, Shari Pfleeger, Jonathan Margulies, "Security in Computing", Fifth Edition, Prentice Hall, New Delhi, 2015.

Facilitating the Achievement of Course Learning Objectives

Unit no.	Course Learning Outcomes	Teaching and Learning Activities	Assessment Tasks
1	• Understand the fundamentals of Cyber Security • Explore Computer Security and its importance • Learn about authentication, access control, and cryptography • Understand various web attacks and how to protect against them • Explore network vulnerabilities and scanning techniques	• Lecture on the introduction to Cyber Security • Explanation of computer security, threats, vulnerabilities, and controls • Practical exercises on authentication, access control, and cryptography • Explanation of web attacks, browser attacks, and email attacks • Introduction to vulnerability scanning, network sniffers, and injection tools	• Quiz on Cyber Security basics • Writing a short essay on the importance of Cyber Security • Implementing authentication and access control measures • Identifying and mitigating web vulnerabilities • Conducting network vulnerability scans
2	• Learn about network defense tools and techniques • Understand the role of firewalls and packet filters • Explore VPNs and their basic concepts • Learn about intrusion detection systems (IDS) • Explore web application scanning and security tools • Learn about scanning tools like Nikto and W3af	• Lecture on firewalls, packet filters, and VPNs • Practical exercises on configuring firewalls and packet filters • Explanation of Virtual Private Networks (VPNs) • Introduction to intrusion detection systems (IDS) • Lecture on web application security, scanning tools, and password cracking • Practical exercises with Nikto, W3af, and HTTP utilities	• Configuring firewalls and VPNs • Implementing packet filtering rules • Setting up a VPN for secure communication • Configuring and using Snort IDS • Conducting web vulnerability scans • Identifying and addressing web vulnerabilities

Unit no.	Course Learning Outcomes	Teaching and Learning Activities	Assessment Tasks
3	• Understand application inspection tools like ZAP and Sqlmap • Learn about password cracking and brute-force tools	• Explanation and hands on practice with Zed Attack Proxy (ZAP) • Introduction to password cracking tools and techniques	• Conducting application security assessments • Cracking passwords and evaluating password security
4	• Gain insights into Cyber Crime, laws, and investigation • Understand the types of Cybercrime and attack vectors • Learn about cyber laws and regulations	• Lecture on Cyber Crime, types, and incident response • Explanation of hacking, attack vectors, and digital forensics • Practical exercises on Indian IT Act 2000 and cyber laws	• Quiz on Cyber Crime and laws • Investigating a simulated cybercrime incident • Analyzing legal aspects of Cyber Security incidents
5	• Explore various contemporary Cyber Security threats and attacks • Understand the risks associated with different types of attacks Learn about SQL injection, buffer overflow, and wireless network attacks	• Introduction to contemporary Cyber Security threats and attacks • Explanation of password cracking, keyloggers, viruses, and malware • Practical exercises on SQL injection, buffer overflow, and wireless attacks	• Identifying and mitigating Cyber Security threats and attacks • Evaluating and mitigating security risks associated with attacks Conducting simulated attacks and defending against them

VALUE ADDED COURSE

3HYEV206: Yoga Education

(Credit: Practical -2 Tutorial - 1)

Scheme of Examination

Course Details				End Term Practical Exam		Lab Performance		Credit Distribution			Allotted Credits
Course Code	Course Type	Course Title	Total Marks	Major		Minor Sessional ***		L	T	P	Subject wise Distribution
				Max Marks	Min Marks	Max Marks	Min Marks				
Practical Group											
3HYEV206	Value added course	Yoga Education	100	60	20	40	14	-	1	2	3

Objectives:

- To provide an understanding of the meaning and definition of Yoga.
- To identify the aims and objectives of Yoga.
- To analyze the role of Yoga in Early Upanishads.
- To understand the Yoga Sutra: General Consideration.
- To recognize the need and importance of Yoga in Physical Education and Sports.

Outcomes:

- Understand the definitions and concepts of Yoga.
- Describe the historical development of Yoga in India.
- Know the major schools of Yoga.
- Demonstrate the different stages of the Surya Namaskar.
- Name the different types of Asanas.
- Analyze the preventive and curative effects of Yoga.

Syllabus:

Unit 1: Introduction

- Meaning, History and Development of Yoga.
- Aims and Objectives of Yoga, Time and food.
- The Yoga Sutra: General Consideration.
- Need and Importance of Yoga.

Unit 2: Foundation of Yoga

- Various kind of Yoga (Bhakti yoga, karma yoga, hatha yoga, and Ashtang yoga).
- General guidelines for yoga practice.
- Yoga practice for health and wellness.

Unit 3: Asanas

- Effect of Asanas and Pranayama on various system of the body Classification of asanas.
- Influences of relatives, meditative posture on various system of the body.
- Types of Bandhas, mudras and kriyas.

Unit 4: Yoga Education

- Basic, applied and action research in Yoga.
- Difference between yogic practices and physical exercises.
- Yoga education centers in India and abroad.

Unit 5: Yoga and Holistic Health

- Holistic Health and Yoga- Explore the concept of holistic health and how yoga contributes to overall well-being, including physical, mental, and emotional health.
- Yoga for Stress Management - Examine the role of yoga in managing stress and promoting relaxation, with a focus on specific techniques and practices.
- Yoga and Nutrition - Discuss the connection between yoga and nutrition, emphasizing the importance of a balanced diet for a healthy lifestyle.
- Yoga Philosophy and Ethics - Delve into the ethical and philosophical aspects of yoga, including concepts like Ahinsa (non-violence) and Dharma (duty), and how they can be applied in daily life.

Practical:

- Prayer: Concept and recitation of pranava.
- Surya Nasmaskar
- Aasana- (Uttanpadasan, Halasan, Pawanmuktasan, Makrasan, Bhujangasan Shaslabhasan, Dhanurasan, Ardha-Mastsyendrasan, Janushirasan, Supta-Vajrasan, Chakrasan, Tadasa, Uktatasan, Padamsan, Gomukhasan, Vajrasan, Pashchimottasan, Sarvangasan, Matsyasan.)
- Chalana kriya/ Loosening Practice
  - Neck Movement
  - Shoulder movement
  - Bhuja Valli shakti vikasaka
  - Purna Bhuja shakti vikasaka
  - Knee Movement
- Yogasana Standing Posture – Tadasana, vrikshasana, Ardha Chakrasana, sarwangasana, trikonasana Sitting posture – Bhadrasana, vajrasana, Ardha- ushtrasana, shashankasana, vakrasana Prone Posture- Makarasana, bhujangasana, Shalabhasana Supine posture- Ardhasana, Setubandhasana, pawanmuktasana, shavasana.
- Pranayam (Anulom-vilom, Nadi-Shodhan, Surya, Bhedi Ujjayi, Shitkari, Sheetali, Bhastrika, Bhramri.)
- Shat-Karma (Cleansing process) (Jal-Neti, Sutra Neti, Kunjal, Trataka, Kapalbhati)
- Mudra (Mahamudra, Mahabandha, Viparitkarani, Shambhri, Kaki)
- Dhyan (Meditation): "OM" recitation, Body Awareness, Breath Awareness, yoga nidra.
- Viva
- Practical work

Reference Books

- Gupta S.N. Dass Yoga Philosophy Dr. Bhardwaj Ishwar Upnishdhik & Adhyatmik Yigyan.
- Swami Kuvalayananda Hathyog Preedipika Mukherjee, Wishvananth Bharat Ke Mahaan Yogies.
- Swami Tirth, Omanand Patanjali Yog Pradeep Swami Kuvalayananda Pranayam.
- Swami Saraswati Sataya Nand Asan Pranayam and Mudra Bandh Bharamchari, Swami Dhirender Yogic Suksham Vigyan.
- Dr. Nagendra H.R. Pranayama the Arts & Science.
- Swami Kuvalayananda Yogic Chikitisa Ananda Swamy Shankaradev Yogic management & Common.

Facilitating the Achievement of Course Learning Objectives

Unit no.	Learning Outcome	Teaching and Learning Activities	Achievements
1	Understand the meaning and definition of yoga.	Lecture and discussion on the concept and definition of yoga. - Reading assignments on the history and evolution of yoga.	Define yoga and its historical context.
2	Identify the aims and objectives of yoga practice.	Group discussions on the purposes of practicing yoga. - Research projects on the benefits of yoga in various aspects of life.	List the aims and objectives of yoga.
3	Trace the presence of yoga in early Upanishads.	Analysis of select Upanishadic texts with references to yoga. Group presentations on the historical development of yoga.	Summarize the influence of Upanishads on yoga.
4	Summarize the Yoga Sutra and its general considerations.	In depth study of Patanjali's Yoga Sutras and their significance. Group debates on the key principles in the Yoga Sutra.	Explain the fundamental concepts in the Yoga Sutra.
5	Recognize the need and importance of yoga in physical education and sports.	Guest lectures by yoga experts in sports and physical education. Practical sessions of yoga for athletes and physical education students.	Identify the benefits and relevance of yoga in sports and physical education.

VALUE ADDED COURSE

3HCIV206: Contemporary India

(Credit: Theory -3 Tutorial - 0)

Scheme of Examination

Course Code	Course Name	Credit	Maximum marks Allotted						Duration of Exam.	
			Theory			Practical		Total	Theory	Practical
			End Sem	Mid Sem	Assign	End Sem	Term Sem			
3HCIV206	Contemporary India	3(3+0)	60	20	20	-	-	100	3 hr	-

Course Objective

- Develop a clear and comprehensive understanding of the definition and scope of Contemporary India.
- Identify and critically analyze the key elements that define the contemporary period.
- Trace and summarize the post-independence historical background, highlighting major events and their significance.
- Evaluate the impact of historical developments on the current socio-political and economic landscape.
- Examine India's demographic profile, including population distribution, age structure, and regional diversity.
- Analyze the cultural and linguistic diversity within India and its implications for national identity.
- Understand the trajectory of economic growth in India, including key sectors and challenges.
- Analyze the role of economic policies in shaping India's growth and development.
- Evaluate social indicators such as education, health, and poverty, understanding their significance in measuring societal well-being.
- Examine the interconnections between social indicators and their impact on the overall quality of life.

Course Outcome

- Students will articulate a precise definition of Contemporary India, demonstrating an understanding of its multi-dimensional nature.
- Students will categorize and interpret key aspects defining the scope of Contemporary India.
- Students will construct a chronological timeline of post-independence events, demonstrating an understanding of their historical context.
- Students will assess the significance of historical events in shaping the contemporary landscape.
- Students will analyze India's demographic landscape, producing insights into population distribution and diversity.
- Students will recognize and appreciate the cultural diversity within India, linking it to the nation's identity.
- Students will explain the trajectory of economic growth in India, illustrating their understanding of key economic sectors.
- Students will critically assess economic challenges, demonstrating an understanding of their complexities.
- Students will interpret social indicators, showcasing their ability to evaluate education, health, and poverty metrics.
- Students will demonstrate an understanding of the interconnectedness of social indicators and their implications for societal well-being.

Syllabus:

Unit 1: Introduction to Contemporary India

- Definition and scope of Contemporary India
- Historical background: post-independence period
- Demographic profile and diversity
- Economic overview: Growth, sectors, and challenges
- Social indicators: Education, health, and poverty

Unit 2: Political Landscape

- Constitution of India: Features and amendments
- Political institutions: Parliament, President, Prime Minister, Judiciary
- Electoral system: Elections, political parties, and regional dynamics
- Major political issues and challenges

Unit 3: Economic Development

- Economic planning and policies
- Agriculture: Green Revolution, challenges, and reforms
- Industry and services sector
- Infrastructure development
- Economic inequality and inclusive growth

Unit 4: Social Issues and Cultural Dynamics

- Social diversity: Caste, religion, ethnicity, and language
- Gender issues: Women empowerment, equality, and challenges
- Cultural heritage: Art, literature, music, and cinema
- Urbanization and changing lifestyles

Unit 5: Contemporary Challenges and Future Prospects

- Environmental challenges: Climate change, pollution, and conservation
- Technological advancements and their impact
- Globalization and India's role in the international community
- Future prospects: Opportunities and challenges

Recommended Texts:

- "India After Gandhi" by Ramachandra Guha
- "India Unbound" by Gurcharan Das
- "The Argumentative Indian" by Amartya Sen
- "Pax Indica" by Shashi Tharoor
- Articles and research papers on contemporary issues

Reference Books

- Author: Ramachandra Guha, Book Title: "India After Gandhi: The History of the World's Largest Democracy", Publication Year: 2007
- Author: Bipan Chandra, Mridula Mukherjee, Aditya Mukherjee, and Sucheta Mahajan, Book Title: "India Since Independence", Edition: 1st Edition Publication Year: 2008
- Author: Amartya Sen, Book Title: "The Argumentative Indian: Writings on Indian History, Culture and Identity", Edition: 1st Edition, Publication Year: 2005
- Author: Shashi Tharoor, Book Title: "Pax Indica: India and the World of the 21st Century", Edition: 1st Edition, Publication Year: 2012
- Author: Arvind Panagariya, Book Title: "India: The Emerging Giant", Edition: Updated and Expanded Edition Publication Year: 2011

Facilitating the Achievement of Course Learning Objectives

Unit no.	Learning Outcome	Teaching and Learning Activities	Achievements
1	● Introduction to Contemporary India ● Definition and scope of Contemporary India ● Historical background: post-independence period ● Demographic profile and diversity ● Economic overview Growth, sectors, and challenges ● Social indicators Education, health, and poverty	● Lectures and discussions Case studies on demographic trends Analysis of economic indicators Research projects on social issues	● Increased understanding of Contemporary India Enhanced analytical skills
2	● Political Landscape ● Constitution of India: Features and amendments ● Political institutions: Parliament, President, Prime Minister, Judiciary Electoral system: Elections, political parties, and regional dynamics ● Major political issues and challenges	● Interactive sessions on constitutional features Role-playing exercises on political processes De-bates on major political issues	● Improved understanding of India's political landscape Enhanced debating and critical thinking skills ●
3	● Economic Development ● Economic planning and policies ● Agriculture: Green Revolution, challenges, and reforms ● Industry and services sector ● Infrastructure development ● Economic inequality and inclusive growth	● Guest lectures from economists Case studies on economic policies Field visits to industries and farms	● Increased awareness of economic policies Practical insights into economic sectors
4	● Social Issues and Cultural Dynamics ● Social diversity: Caste, religion, ethnicity, and language ● Gender issues: Women empowerment, equality, and challenges ● Cultural heritage: Art, literature, music, and cinema ● Urbanization and changing lifestyles	● Group discussions on social diversity Workshops on gender equality Cultural events and presentations	● Improved sensitivity to social issues Enhanced understanding of cultural diversity
5	● Contemporary Challenges and Future Prospects ● Environmental challenges: Climate change, pollution, and conservation Technological advancements and their impact	● Seminars on environmental challenges Analysis of technological impacts Model United Nations (MUN) simulations	● Heightened awareness of global issues Improved diplomatic and negotiation skills

Unit no.	Learning Outcome	Teaching and Learning Activities	Achievements
	● Globalization and India's role in the international community ● Future prospects: Opportunities and challenges		

RAMANUJAN SCHOOL OF SCIENCE

BACHLOR OF SCIENCE

(Microbiology)

(B. Sc. (Microbiology) – CKUG04C03)

III Semester

MAJOR CORE COURSE-I

3SPBC303: Microbiology III – Principle of Bioinstrumentation and Techniques

(Credits: Theory-4 Practical-2)

Scheme of Examination

Course Code	Course Name	Credits	Maximum Marks Allotted						Duration of exam	
			Theory			Practical		Total	Theory	Practical
			End Sem	Mid Sem	Assign	End Sem	Term Sem			
3SPBC303	Principle of Bioinstrumentation and Techniques	6(4+0+2)	60	20	20	60	40	200	3hr	2hr

Course Objective

- Learn the qualitative functions of the four primary system components and technical vocabulary associated with instrumentation, design and basic signal analysis and static analysis.
- They will also understand the principles and applications of centrifugation and ultracentrifugation techniques.

Course Outcomes

- provide the reader with a tool to help select the most appropriate instrument for use in an observational study.
- Students will understand the principles and applications of staining techniques, including simple staining, differential staining, and negative staining.
- Students will learn the principles and requirements of animal tissue culture, including decontamination, sterilization, and disinfection methods.

Syllabus: Theory Credits (4-0-2)

UNIT – I

Colorimeter and spectrophotometry, Spectro-fluorimetry, turbidometry, nephelometry, luminometry, pH meter. Chromatography; adsorption partition, column, gas ion-exchange, gel Filtration and affinity Chromatography, HPLC, FPLC.

UNIT – II

Principle and application of staining techniques Definitions-Stain, Dye, Simple Staining, Differential Staining, Negative Stanning. Principle of Staining Techniques- cell wall, capsule, flagella, endospore, cytoplasmic inclusions, acid fast stain, GIEMSA stain and Negative staining.

UNIT – III

Centrifugation and ultracentrifugation: Microscopy- light, phase-contrast, fluorescence, dark field, electron microscopy. Laser, confocal, microscopy and digital image analysis.

UNIT - IV

Definitions- Pure Culture, Auxenic culture, Mixed Culture, isolates, strains, Tissue culture techniques; Principal and requirements of animal tissue culture Decontamination, sterilization, and disinfection. Pure culture techniques: pour plate, streak plate and spread plate method.

UNIT – V

Electrophoresis technique types and their application; Electrophoresis of proteins and nucleic acids. Enzyme purification and assay techniques gel electrophoresis, SDS-PAGE, NATIVEPAGE, Isoelectric focusing, 2- D PAGE, Western Blotting, Southern blotting, Northern blotting.

Practical (Credits 2)

- Exercise on colorimeter/spectrophotometer/pH meter.
- Exercise on paper, thin layer, column chromatography
- Exercise on paper and gel electrophoresis
- Exercise on tissue culture techniques.
- Absorbance curve for dyes.
- Testing of Beer's law
- Exercise on Tissue culture techniques
- To study Gram's staining.
- To study Isolation of pure cultures of bacteria by streaking method.

Textbook

1. A Text Book of Microbiology by D. K. Maheshwari.
2. Microbiology book by – Michael J. Pelczar and L.C.S. chain.
3. A text book of microbiology by Anantha Narayan and Paniker's.

Reference Book

1. "Principles and Techniques of Biochemistry and Molecular Biology" by Keith Wilson and John Walker - Published by Cambridge University Press.
2. "Molecular Biology Techniques: An Intensive Laboratory Course" by Sue Carson, Heather Miller, and D. Scott Witherow - Published by Academic Press.
3. "Microscopy Techniques in Biotechnology" by Pradeep Kumar - Published by CRC Press.
4. "Electrophoresis: Theory, Methods, and Applications" by Pierre-Gilles de Gennes, Françoise Brochard- Published by Springer.

Facilitating the achievement of course learning objectives

Unit no.	Course learning outcomes	Teaching and learning activities	Assessment task
1	Understand the principles of colorimetry and spectrophotometry and their applications in quantifying the concentration of chemical compounds. Also understands bio instrument pH meter.	Describe the fundamentals of spectrofluorimetric and its utility in analyzing fluorescent molecules. Demonstrate proficiency in pH meter, including the calibration and accurate measurement of pH levels in various solutions.	Quiz, Multiple Choice Questions, Assignments bio instruments.
2	Students will be able to. Understand the differences between High-Performance Liquid Chromatography (HPLC) and Fast Protein Liquid Chromatography (FPLC).	Describe the principles of various chromatographic techniques, including adsorption, partition, column, gas, ion-exchange, gel filtration, and affinity chromatography.	Class tests focusing on different type chromatography and its methods.
3	Students will understand the principles of centrifugation and ultracentrifugation and their applications in separating particles and molecules based on density.	Describe the various microscopy techniques, including light, phase-contrast, fluorescence, dark field, electron microscopy, and their respective uses in visualizing biological and chemical specimens	Student presentations, Quiz, Assignments on the types of Microscopies.
4	Students will understand the principles of tissue culture techniques and their significance in the growth and maintenance of animal cells and tissues.	Describe the essential requirements for successful animal tissue culture, including culture media, aseptic conditions, and appropriate incubation parameters.	Quiz, Multiple Choice Questions, Assignments.
5	Students will understand the practical applications of electrophoresis and enzyme assays in biochemistry and molecular biology research.	Explain the principles and methods of enzyme purification and assay techniques, including enzyme kinetics and activity measurements.	Multiple choice questions, Practical assessment.

MINOR CORE COURS

3SBSM304: Botany-III (Biodiversity and Systematic of Seed Plant)

(Credits: Theory-4 Practical-2)

Scheme of Examination

Course Code	Course Name	Credits	Maximum Marks Allotted						Duration of exam	
			Theory			Practical		Total	Theory	Practical
			End Sem	Mid Sem	Assign	End Sem	Term Sem			
3SBSM304	Botany-III (Biodiversity and Systematic of Seed Plant)	6(4+0+2)	60	20	20	-	-	100	3hr	2hr

Course Objectives

- Discuss the type of seeds produced by gymnosperms, as well as other characteristics of gymnosperms.
- State which period saw the first appearance of gymnosperms and explain when they were the dominant plant life.
- List the four groups of modern-day gymnosperms and provide examples of each.
- To appreciate the fantastic commonness existing among organisms.
- The student will be able to appreciate the uniqueness of different groups and the way they are classified.

Course Learning Outcome

- Study of gymnosperms will help the students understand the connecting link between the lower and higher organisms in the plant kingdom.
- The anatomy imparts a thorough knowledge about the internal structure and relationship between tissues and evolution.
- An appreciation of seed plant diversity.
- A basic understanding of the principles of phylogenetic systematic.
- An overview of the diagnostic characters of the main lineages of seed plants.
- An understanding of the methods and principles of classification and nomenclature.

Syllabus

Credits: 2-0-2

UNIT – I

Gymnosperm: General characteristics and classification of gymnosperms, Heterospory and origin of seed habit, Evolution and diversity of gymnosperms, Geological time scale, and fossilization. Fossil gymnosperms: *Lyginopteris* and *Williamsonia.*

UNIT – II

Gymnosperm: General account of Cycadodiofilicales, Bennettitales and *Gnetales*. General account of *Ginkgoales*. Morphology, anatomy, reproduction and life cycle of *Cycas*, *Pinus* and *Ephedra*.

UNIT – III

Taxonomy: Origin and evolution of angiosperms, Fundamental components of 6, 7, 8 taxonomy, Plant Identification, Principles and rules of botanical nomenclature, Museum, Herbarium and botanical gardens; Classification of angiosperms: Bentham and Hooker, Hutchinson, Modern trends in taxonomy including molecular taxonomy.

UNIT – IV

Taxonomy: Terminology for plant description in semi technical language: Diagnostic characteristics and economic importance of families -*Ranunculaceae*, *Brassicaceae*, *Malvaceae*, *Rutaceae*, *Fabaceae*, and *Apiaceae*. *Rosaceae Cucurbitaceae.*

UNIT – V

Taxonomy: Diagnostic characteristics and economic importance of families – *Rubiaceae, Asteraceae*, *Musaceae, Asclepiadaceae*, *Solanaceae*, *Lamiaceae*, *Euphorbiaceae*, *Liliaceae* and *Poaceae*.

Practical Content

Credits :2

- Study of microscope.
- Study of prepared slide of T.S. of young root *Cycas*.
- Study of prepared slide of V.S of leaf let *Cycas*.
- Study of prepared slides of T.S of young root *Pinus*.
- Study of prepared slide of T.S. of young stem *Pinus*.
- Study of prepared slide of T.S. of root *Ephedra*.
- Study of prepared slide of V.S of leaf *Ephedra*.
- Study of *Brassicaceae* family (*Brassica Campestris var. sarson*) up to family level.
- Study of *Malvaceae* family (*Hibiscus rosasinensis*) up to family.
- Study of family *Solanaceae* (*Solanum nigrum*) up to family level.

Reference Book

- Plant Taxonomy and Biodiversity – N.D. Paria.
- Plant Taxonomy – Dr. Prithipal Singh festschrift.2012.
- Characteristics and Systematic of Seed Plants – Singh, Pande, Jain.
- Biodiversity Conservation and Systematics – Dr. Prithipal Singh.

Text Book

- A Text Book of Botany Diversity and Systematic of Seed Plant – Singh, Pande, Jain.
- A Text Book of Systematic Botany 7th Edition – Raj Kumar Gupta.
- A Text Book of Botany – Dr. R.K. Singh.

Facilitating the achievement of course learning objectives

Unit No.	Course Learning Outcome	Teaching and Learning Activities	Assessment Tasks
1	Understand the anatomical and morphological features of gymnosperms, including leaf types, stem structures, and root systems. Students should be able to recognize and explain the adaptations of gymnosperms for various environments.	Provide students with gymnosperm specimens or cones. Have students examine and dissect the specimens to observe and document reproductive structures. Discuss the significance of these structures in gymnosperm reproduction.	Class test focusing and short questions.
2	Understand the anatomy of *Cycas, Pinus, Ephedra*. Plants, including their unique reproductive structures such as cones and	Begin with an introductory lecture on gymnosperms, their evolutionary history, and their significance in	Class test focusing on definitions and short questions.

Unit No.	Course Learning Outcome	Teaching and Learning Activities	Assessment Tasks
	seeds. Explain the *cycas* life cycle and reproductive strategies.	ecosystems. Discuss the distinct features of *Cycas* plants.	
3	Students should be able to explain the evolutionary history of angiosperms, including their origin and diversification. This may include discussing their relationships with other plant groups.	Start with a brief overview of what angiosperms are, highlighting their importance as the most diverse and abundant group of plants on Earth.	Class test focusing on definitions and short and long questions.
4	Understand the principles of taxonomy and classification, including the hierarchical organization of life forms into families, genera, species, and more. Appreciate the vast biodiversity on Earth and recognize the role of biological families in organizing and categorizing this diversity.	Assign each student or group a specific plant family to research and present to the class, including information on its economic significance.	Class test focusing on and short questions.
5	Recognize and describe plant families that are economically significant, such as *Poaceae, Solanaceae* and *Liliaceae* family	Assign case studies on plant families like *Poaceae*, *Solanaceae.* Family Have students research and present the economic significance of these families in terms of crop production, medicinal plants, and more.	Class test focusing on and long questions.

MINOR CORE COURS

3SPIM304: Chemistry –III (Physical, Inorganic and Organic Chemistry)

(Credits: Theory-4 Practical-2)

Scheme of Examination

Course Code	Course Name	Credits	Maximum Marks Allotted						Duration of exam	
			Theory			Practical				
			End Sem	Mid Sem	Assign	End Sem	Term Sem	Total	Theory	Practical
3SPIM304	Chemistry –III (Physical, Inorganic and Organic Chemistry)	6(4-0-2)	60	20	20	60	40	200	3 hr	2 hr

Course Objectives

- Grasp fundamental concepts and laws, understand entropy and its role in spontaneity and equilibrium.
- Learn enthalpy changes, Hess's law, and enthalpy of formation and neutralization reactions.
- Understand adsorption, catalysis, and surface area determination.
- Learn properties, compounds, complexes, and comparative treatment of transition elements.
- Understand coordination compounds, oxidation-reduction principles, and reactions of alcohols and phenols.

Course Learning Outcome

- Ability to apply thermodynamic principles to understand spontaneity and equilibrium in chemical systems.
- Proficiency in calculating enthalpy changes and understanding their applications in various reactions.
- Understanding adsorption phenomena, catalysis, and methods for determining surface area.
- Grasping the properties, compounds, and complexes of transition elements.
- Mastery of coordination compounds, oxidation-reduction principles, and reactions of alcohols and phenols.

Syllabus **Credits: 4-0-2**

Physical Chemistry

UNIT – I

Thermodynamics

Basic concepts of thermodynamics. first law, second law of thermodynamics: Need for the law, different statements of the law, carnot cycle and its efficiency, carnot theorem. Thermodynamic scale of temperature. Concept of Entropy: Entropy as a function of P & T and T and T & V, entropy change in physical change. Clausius inequality, entropy as criteria of spontaneity and equilibrium. Entropy changes in ideal gases and mixing of gases. Nernst heat theorem, statement and concept of residual entropy, evaluation of absolute entropy from heat capacity data Gibbs and Helmholtz functions. Gibbs function (G) and Helmholtz functions (H) as thermodynamic quantities. A and G as a criterion for thermodynamic equilibrium and spontaneity, their advantage over entropy change.

UNIT – II

Surface Chemistry

Adsorption: Adsorption and absorption, type of adsorption, adsorption of gases and liquids in solid adsorption, Freundlich and Langmuir adsorption isotherms. Surface area and determination of surface area.

Catalysis: Characteristics of catalyzed reactions, classification of catalysis, application of catalysts, miscellaneous examples.

Inorganic Chemistry

UNIT – III

Chemistry of Elements of First Transition Series

Characteristic properties of d-block elements. Properties of the elements of the first transition series, their binary compounds such as carbides, oxides and sulphides. Complexes illustrating relative stability of their oxidation states, coordination number and geometry.

UNIT – IV

Coordination Compounds

Werner's co-ordination theory and its experimental verification, effective atomic number concept, chelates, nomenclature of coordination compounds, isomerism in coordination compounds, VBT of transition metal complexes.

Oxidation and Reduction

Use of redox potential data, analysis of redox cycle. Redox stability in water: Frost, Latimer and Pourbaix diagrams. principles involved in the extraction of elements.

Organic Chemistry

UNIT – V

Alcohols

Classification and nomenclature. Monohydric alcohols: nomenclature, methods of formation, acidic nature and reactions of alcohols. Dihydric alcohols: Nomenclature, methods of formation, chemical reactions. Trihydric alcohols: Nomenclature and methods of formation, chemical reactions.

Practical Content — Credits: 2

Physical Chemistry

- Determination of transition temperature of give substance by thermometric method.
- Verification of beer's lambert law.

Inorganic Chemistry

- Calibration of the fractional weights, pipettes and burettes.
- Quantitative analysis -Volumetric analysis
  a. Determination of acetic acid in commercial vinegar using NaOH.
  b. Estimation of hardness of water by EDTA
- Gravimetric analysis: Barium as barium sulphate Organic Chemistry Laboratory Techniques.

Organic Chemistry

- Thin layer chromatography Determination of Rf values and identification of organic compounds.
  a. Separation of green leaf pigments (spinach leaves may be used).
- Paper chromatography: Ascending and Circular Determination of Rf values and identification of organic compounds.
  a. Separation of a mixture of phenylalanine and glycine, alanine and aspartic acid, leucine and glutamic acid. Spray reagent ninhydrin.

Text Books

- Unified Chemistry by Tandon, Rathore and Agarwal.
- Physical Chemistry by P. W. Atkins and Julio de Paula.
- Inorganic Chemistry by Gary L. Miessler and Paul J. Fischer.
- Organic Chemistry by Jonathan Clayden, Nick Greeves, and Stuart Warren.
- Surface Chemistry by Arne Östlund.
- Transition Metal Chemistry the Valence Shell in d-Block Chemistry by Malcolm S. Cresser.

Reference Books

- Chemical Kinetics and Reaction Dynamics by Paul L. Houston.
- Thermodynamics, Statistical Thermodynamics, and Kinetics by Thomas Engel and Philip Reid.
- Introduction to Catalysis by Robert J. Farrauto and Lucas Dorazio.
- Principles of Inorganic Chemistry by Brian W. Pfennig and Kimberly A. Pfennig.
- Advanced Organic Chemistry Reactions, Mechanisms, and Structure" by Jerry March.

Facilitating the achievement of course learning objectives

Unit No.	Course Learning Outcome	Teaching and Learning Activities	Assessment Tasks
1	The laws of thermodynamics, including the zeroth law, first law (conservation of energy), second law (entropy and the direction of processes), and third law (absolute zero and entropy).	Traditional lectures can be used to introduce and explain key thermodynamic concepts, laws, and principles. Visual aids, diagrams, and animations can enhance understanding.	Quiz assessing understanding of basic thermodynamic concepts.
2	Understanding the fundamental principles of surface chemistry, including surface tension, adsorption and interface phenomena.	Covering fundamental concept, theories and principles of surface chemistry. Showing surface phenomena using visual aids or experiments.	Homework assignments on catalytic mechanisms and examples.
3	Describe and compare the fundamental physical and chemical properties of the elements in the first transition series, including atomic and ionic radii, ionization energy, electron affinity, and magnetic properties.	Assign each student or group of students an element from the first transition series. Have them create profiles that include key information like electron configuration, physical properties, and common uses. Present these profiles to the class.	Written exam on the characteristic properties of transition elements.
4	Coordination compounds and describe their distinctive features, including the central metal ion or atom, ligands, and coordination number.	Provide students with molecular modelling software or kits to build and visualize coordination complexes. This hands-on approach helps students understand three-dimensional structures.	Quiz on Werner's coordination theory and effective atomic number concept.
5	Classification and nomenclature and Chemical reaction of Alcohols and Phenols.	Begin with traditional lectures to introduce the basic concepts of Alcohols and Phenols.	Class test focusing on long questions.

ABILITY ENHANCEMENT COURSE (AEC)

3HCSA301: COMMUNICATION SKILL

(Credit: Theory - 2 Tutorial -0)

Scheme of Examination

Course Code	Course Name	Credit	Maximum marks Allotted						Duration of Exam.	
			Theory			Practical		Total	Theory	Practical
			End Sem	Mid Sem	Assign	End Sem	Term Sem			
3HCSA301	Communication Skill	2(2-0-0)	60	20	20	-	-	100	2 hr	-

Course Objective

- Develop Effective Communication Skills Spoken and written.
- Develop Effective Presentation Skills.
- Conduct Effective business Correspondence, business reports, team management and all-round personality Development.

Course Outcomes

- Projects Role plays, quizzes and Various other participatory sessions. The emphasis will be on learning by doing.
- The student will learn the skills and attributes but also internalize them over a period of time.
- Internalization ensures that the skills and attributes become part of the student's nature. Thus, the changes will be genuine and positive.

Syllabus:

Unit 1: Introduction

General Introduction of self by students, Importance of the Training sessions, Importance of Presentation Skills, Public Speaking

Unit 2: Basic English Grammar

Vocabulary, Kinds of Sentences, Verb, Adverb, Tenses, Preposition, Conjunction, Formation of Sentences, Sentence Making, Translation

Unit 3: Communication Skills

Communication meaning, Function, Process, Types of communication, Guidelines for effective communication, Purpose of Good communication, Importance of right Pronunciation

Unit 4: Listening and Writing Skills

Importance of effective listening, Importance of effective writing skills, Conversation Practice, Guidelines for Effective writing

Unit 5: Body Language

Gestures, Voice Modulation, Eye Contact, Facial Expression, Posture, Dressing Sense, Attire, Hand, movements, General Etiquette, Mannerism, Smiling Gestures, Confidence building. Email Etiquette, Email Drafting

Reference Books

- English Communicative skill by Pramod Singla.
- English Language skill a Practical.
- Communicative skill by Sanjay Kumar & Pushpalata.

Facilitating the Achievement of Course Learning Objectives

Unit	Course Learning Outcome	Teaching-Learning Activities	Assessment Tasks
1	● Understand the basics of communication.	● Lecture on communication fundamentals ● Group discussion on the importance of effective communication ● Role-play exercises demonstrating different communication styles	● Quiz on communication basics Individual reflection on group discussion performance
2	● Develop active listening skills.	● Listening comprehension exercises Class debates with active listening requirements Peer feedback sessions	● Listening comprehension test Debate participation and assessment by peers
3	● Improve verbal communication skills.	● Public speaking workshops ● Mock interviews and feedback sessions. ● Impromptu speech exercises	● Public speaking assessment with feedback ● Mock interview performance evaluation
4	● Enhance non-verbal communication skills.	● Body language analysis and practice activities Group activities emphasizing non-verbal cues Video analysis of non-verbal communication	● Non-verbal communication assessment with peer feedback Written reflection on video analysis
5	● Develop effective written communication skills.	● Writing workshops on emails, reports, and proposals Collaborative document editing exercises Writing assignments on various topics	● Written assignments on emails, reports, and proposals with rubric assessment Peer review of collaborative document editing

SKILL ENHANCEMENT COURSE

3SNGS305: Nursery and Gardening

(Credits: Theory- 0 Tutorial- 1 Practical- 2)

Scheme of Examination

Course Code	Course Name	Credits	Maximum marks Allotted						Duration of Exam.	
			Theory			Practical		Total	Theory	Practical
			End Sem	Mid Sem	Assign.	End Sem	Term work			
3SNGS305	Nursery and Gardening (3rd Sem)	3(0-1-2)	-	-	-	60	40	100	-	2 hr

Course Objectives

- Students will learn to recognize various plant species, including trees, shrubs, flowers, and vegetables, and understand their characteristics.
- Students will grasp the basics of soil types, soil testing, and soil improvement techniques to create optimal growing conditions.
- Students will be able to create garden layouts, taking into account factors like aesthetics, functionality, and plant compatibility.
- Students will learn about plant propagation methods, including seeds, cuttings, and grafting, and choose appropriate techniques for different plant types.

Course Learning Outcomes

- Students will be able to recognize and categorize common plant species, including trees, shrubs, flowers, and vegetables.
- Understand different soil types, conduct soil tests, and apply soil improvement techniques to create optimal growing conditions.
- Develop the ability to plan and design gardens, considering factors such as aesthetics, functionality, and plant compatibility.
- Apply sustainable gardening practices, including composting, water conservation, and the use of native plants.

Syllabus: Credits: 3(0-1-2)

Unit: 1

***Nursery*:** Definition, objectives and scope and building up of infrastructure for *nursery*, planning and seasonal activities planting direct seeding and transplants.

Unit: 2

Seed: Structure and types seed dormancy; causes and methods of breaking dormancy, seed storage: Seed banks, factors affecting seed viability, genetic erosion. Seed production technology, seed testing and certification.

Unit: 3

Vegetative propagation: Air layering, cutting, selection of cutting, collecting season, treatment of cutting, rooting medium and planting of cuttings hardening of plants, greenhouse, mist chamber, shed root, shade house and glass house.

Unit: 4

Gardening: Definition, objectives and scope, different types of gardening landscape and home gardening parks and its components. Plant materials and design, computer applications in landscaping. Gardening operations: Soil laying, manuring, watering, management of pests and diseases and harvesting.

Unit: 5

Sowing/Raising: Seeds and seedlings. Transplanting of seedlings. Study of cultivation of different vegetables: cabbage, brinjal, lady's finger, onion, garlic, tomatoes, and carrots. Storage and marketing procedures.

Practical **Credit: 2**

- Practice of grafting, budding, cutting and layering.
- Anatomical studies of rooting of cuttings and grafting and layout for commercial nursery.
- Sample seed testing, use of bio regulators in propagation, sterilization of equipment's and laboratory.
- Media preparation, selection and preparation of explants, meristem culture and micro grafting, planning and layout of experiments on various aspects of propagation.
- Visit to tissue culture labs and nurseries.
- Preparation of land for vegetable cultivation and sowing of vegetable crops.
- Preparation of nursery beds for raising healthy seedlings of different vegetable crops.
- Methods of training and pruning in tomato.
- Seed sowing methods in nursery.

Reference Books

- Bose T.K. and Mukherjee, D., 1972, Gardening in India, Oxford and IBH Publishing Co. New. Delhi.
- Sandhu. M.K. 1989. Plant Propagation, Wile Eastern Ltd., Bangalore, Madras.
- Kumar. N. 1997. Introduction to Horticulture. Rajalakshmi. Publications. Nagercoil.
- Edmond Musser and Andres, Fundamentals of Horticulture. McGraw Hill Book Co. New. Delhi.
- Agrawal. P.K. 1993. Hand Book of Seed Technology. Dept. of Agriculture and 87 Cooperation. National Seed Corporation Ltd. New Delhi.
- Janick. Jules. 1979. Horticultural Science. (3rd Ed.), W.H. Freeman and Co. San Francisco. U.S.A.

Facilitating the achievement of course learning objectives

Unit no.	Course learning outcome	Teaching and learning activities	Assessment tasks
1	• Define what a nursery is in the context of horticulture. • Explain the significance of nurseries in plant propagation and cultivation.	• Start with a class discussion on what students think a nursery is. Afterward, present the formal definition of a nursery. For objectives, provide case studies of successful nurseries and discuss how they align with the objectives of plant propagation and sales.	• Class text and short and long questions.
2	• Describe the basic structure of a seed, including its key components. • Differentiate between various types of seeds, such as monocotyledonous and dicotyledonous seeds.	• Organize a visit to a local seed bank or invite a representative to discuss the role and importance of seed banks in conserving genetic diversity. Students can engage in discussions about the factors affecting seed	• Class text and short and long questions.

Unit no.	Course learning outcome	Teaching and learning activities	Assessment tasks
		viability and brainstorm solutions for long-term storage	
3	• Explain the principles and significance of vegetative propagation. • Describe different techniques, including air layering and cutting, and their applications.	• Organize a handson workshop on air layering. Provide students with a demonstration of the technique and then allow them to practice air layering on selected plants. Discuss the advantages and applications of air layering.	• Class text and short questions and definitions.
4	• Understand the principles of landscape design and its role in creating visually appealing outdoor spaces • Apply landscape design principles to plan and execute home gardening projects.	• Organize a field trip to a local botanical garden or community garden with various gardening types on display. Allow students to observe and document the characteristics of each type. Follow up with a group discussion and presentations on their findings.	• Class text and short and long questions.
5	• Analyze the growth and development stages of vegetables like cabbage, brinjal, lady's finger, onion, garlic, tomatoes, and carrots. • Apply appropriate cultivation techniques, including soil preparation, watering, fertilization, and pest control, for each vegetable.	• Start with a handson sowing workshop. Provide students with trays, seeds of different vegetables, and potting mix. Guide them through the process of sowing seeds at the correct depth and spacing, labelling trays, and providing proper care for seedlings. Monitor and discuss germination rates.	• Class text and short and long questions.

INTER DISCIPLINARY COURSE

3SMCI302: Mushroom Cultivation

(Credits: Theory-0 Tutorial-1 Practical-2)

Scheme of Examination

Course Code	Course Name	Credits	Maximum marks Allotted						Duration of Exam.	
			Theory			Practical		Total	Theory	Practical
			End Sem	Mid Sem	Assign.	End Sem	Term work			
3SMCI302	Mushroom Cultivation	3(0-1-2)	-	-	-	60	40	100	-	3 hr

Course Objective

- Enable the students to identify edible and poisonous mushrooms.
- Provide hands on training for the preparation of bed for mushroom cultivation and spawn production.
- Give the students exposure to the experiences of experts and functioning mushroom farms.
- Help the students to learn a means of self-employment and income generation.

Course Learning Outcome

By successfully completing the course, students will be able to:

- Identify edible types of mushrooms
- Gain the knowledge of cultivation of different types of edible mushrooms and spawn production
- Manage the diseases and pests of mushrooms
- Learn a means of self-employment and income generation

Syllabus: **Credits: 3(0-1-2)**

Unit 1: Introduction to mushrooms Taxonomical rank History and Scope of mushroom cultivation Edible and Poisonous Mushrooms Vegetative characters.

Unit 2: Common edible mushrooms Button mushroom (Agaricus bisporus), Milky mushroom (Calocybe indica), Oyster mushroom (Pleurotus sajorcaju) and paddy straw mushroom (Volvariella volvcea).

Unit 3: Principles of mushroom cultivation Structure and construction of mushroom house. Sterilization of substrates. Spawn production culture media preparation production of pure culture, mother spawn, and multiplication of spawn. Composting technology, mushroom bed preparation. Spawning, spawn running, harvesting. Cultivation of oyster and paddy straw mushroom. Problems in cultivation diseases, pests and nematodes, weed moulds and their management strategies.

Unit 4: Health benefits of mushrooms Nutritional and medicinal values of mushrooms. Therapeutic aspects antitumor effect.

Unit 5: Post harvest technology: Preservation of mushrooms freezing, dry freezing, drying, canning, quality assurance and entrepreneurship. Value added products of mushrooms.

Practical Sessions

- Different parts of a typical mushroom and variations in mushroom morphology.
- Sterilization of glassware, equipment, and culture media used in mushroom cultivation.
- Preparation of culture media: Potato Dextrose medium, Richard's medium.
- Preparation of spawn: Grain spawn, Straw spawn, Sawdust spawn.
- Preparation of compost and known compost formulations.
- Mushroom bed preparation paddy straw, sugarcane trash, maize straw, banana leaves.
- Cultivation of White button mushroom.
- Cultivation of Paddy straw mushroom.
- Cultivation of Oyster mushroom.
- Cultivation of Milky mushroom.
- Nutrient profiling and Medicinal value of mushrooms.
- Hands on training in Mushroom cultivation farm.
- Diseases of Mushrooms.

Reference Books

- Marimuthu, T. et al. (1991). Oster Mushroom. Department of Plant Pathology. Tamil Nadu Agricultural University, Coimbatore.
- Nita Bhal. (2000). Handbook on Mushrooms. 2nd ed. Vol. I and II. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi
- Pandey R.K, S. K Ghosh, 1996. A Hand Book on Mushroom Cultivation. Emkey Publications.
- Pathak, V. N. and Yadav, N. (1998). Mushroom Production and Processing Technology

Facilitating the achievement of course learning objectives

Unit no.	Course learning outcome	Teaching and learning activities	Assessment tasks
1	• Mushrooms belong to the kingdom Fungi. Within the fungi kingdom, they are further classified into the phylum Basidiomycota and the class Agaricomycetes. Mushrooms encompass a wide variety of species, each with its unique characteristics and properties.	• Have students create a timeline of significant events in the history of mushroom cultivation, including key discoveries, cultivation methods, and cultural uses.	• Class text and short and long questions.
2	• Students will be able to identify and classify common edible mushrooms, including the Button mushroom, Milky mushroom, Oyster mushroom, and paddy straw mushroom, based on their morphological characteristics.	• In the classroom or lab, provide fresh specimens of the mushrooms and teach students how to identify them based on physical characteristics, such as cap shape, gill structure, spore colour, and stem features.	• Class text and short and long questions.
3	• Students will have a strong foundation in the fundamental principles of mushroom cultivation, including the life cycle of mushrooms and the key factors influencing their growth.	• Organize field visits to mushroom houses or facilities to demonstrate the design and construction of a mushroom house. allow students to participate in planning and designing their own mushroom house as a group project.	• Class text and short questions and definitions

Unit no.	Course learning outcome	Teaching and learning activities	Assessment tasks
	• Analyse the nutritional components of mushrooms, including vitamins, minerals, proteins, fibre, and carbohydrates. discuss how mushrooms fit into a balanced diet.	• Conduct lectures to introduce students to various mushroom species, their classification, and general characteristics Engage students in discussions about the importance of mushrooms in human nutrition and health.	• Class text and short and long questions.
5	• Explain the significance of postharvest technology in preserving the quality and extending the shelf life of mushrooms.	• Conduct introductory lectures to explain the importance of postharvest technology in mushroom preservation. Engage students in discussions to explore the challenges and opportunities in the mushroom industry.	• Class text and short and long questions.

RAMANUJAN SCHOOL OF SCIENCE

BACHLOR OF SCIENCE

(Microbiology)

(B. Sc. (Microbiology) – CKUG04C03)

IV Semester

MAJOR CORE COURSE-I

3SEMC403: Microbiology –IV Environmental and Medical Microbiology

(Credits: theory-4, Practical-2)

Scheme of Examination

Course Code	Course Name	Credits	Maximum Marks Allotted						Duration of exam	
			Theory			Practical				
			End Sem	Mid Sem	Assign	End Sem	Term Sem	Total	Theory	Practical
3SEMC403	Environmental and Medical Microbiology	6(4+0+2)	60	20	20	60	40	200	3hr	2hr

Course Objectives

- The study of the composition and physiology of microbial communities in the environment.
- It also includes the study of microorganisms that exist in artificial environments such as bioreactors.
- The taxonomic, ecological, and genetic relationships among microorganisms, and the biotechnological application of microorganisms to solve environmental problems.

Course Outcome

- An awareness of the need for a good understanding of how microorganisms react in the environment, and this has been heightened from time to time as detrimental microbial activities become evident under certain conditions.
- study of the relationships of microorganisms with each other and with their environments.

Syllabus: Theory (4-0-2) (Credits)

UNIT – I

Normal microflora of the human body and host pathogen interaction

Normal microflora of the human body: Importance of normal microflora, normal microflora of skin, throat, gastrointestinal tract, urogenital tract, Host pathogen interaction: Definitions - Infection, Invasion, Pathogen, Pathogenicity, Virulence, Toxigenicity, Carriers and their types, Opportunistic infections, Nosocomial infections. Transmission of infection, Pathophysiologic effects of LPS.

UNIT – II

Bacterial diseases List of diseases of various organ systems and their causative agents. The following diseases in detail with Symptoms, mode of transmission, prophylaxis and control. **Respiratory Diseases**: *Streptococcus pyogenes, H. influenzae, Mycobacterium tuberculosis,* **Gastrointestinal Diseases**: *Escherichia coli, Salmonella typhi, Vibrio cholerae,*

UNIT – III

Viral diseases: List of diseases of various organ systems and their causative agents. The following diseases in detail with Symptoms, mode of transmission, prophylaxis and control Polio, Herpes, Hepatitis, Rabies, Dengue, AIDS,

Protozoan diseases: List of diseases of various organ systems and their causative agents. The following diseases in detail with Symptoms, mode of transmission, prophylaxis and control Malaria, Kala-azar.

UNIT – IV

Microorganisms and their Habitats:

Structure and function of ecosystems, Terrestrial Environment: Soil profile and soil microflora. Aquatic Environment: Microflora of fresh water and marine habitats. Extreme Habitats; Extremophiles Microbes thriving at high & low temperatures, pH, high hydrostatic & osmotic pressures, salinity, & low nutrient levels.

Microbial Bioremediation: Principles and degradation of common pesticides, organic (hydrocarbons, oil spills) and inorganic (metals) matter, biosurfactants.

UNIT – V

Waste Management: Solid Waste management: Sources and types of solid waste, Methods of solid waste disposal (composting and sanitary landfill) Liquid waste management: Composition and strength of sewage (BOD and COD), Primary, secondary (oxidation ponds, trickling filter, activated sludge process and septic tank) and tertiary sewage treatment.

Practical

- Isolation of microorganisms from air soil and water.
- Isolation of pathogenic microorganisms.
- Study of rhizospheric and phyllospheric microbes from economically important Plants.
- Biodegradation of some organic molecules
- Microbial assessment of potable water'
- Analysis of sewage waste, solid waste (garbage)
- Determination of BOD of waste water sample.

Textbook

1. A Text Book of Microbiology by D. K. Maheshwari.
2. Microbiology book by – Michael J. Pelczar and L.C.S. chain.
3. Text book of microbiology by C.P. Baweja.
4. A text book of microbiology by Anantha Narayan and Paniker.

Reference Book

1. "Microbiology: An Introduction" by Gerard J. Tortora, Berdell R. Funke, and Christine L. Case - Pearson Education
2. General Microbiology by Stanier RY, Ingrahm JI, Wheelis ML and Painter PR. (1987). 5th edition, McMillan Press
3. Environmental Engineering: Water, Wastewater, Soil and Groundwater Treatment and Remediation" by Nelson L. Nemerow and Franklin J. Agardy - John Wiley & Sons
4. "Medical Protozoology" by Patricia J. Johnson and Tommy W. McGaha - CRC Press

Facilitating the achievement of course learning objectives.

Unit no.	Course learning outcomes	Teaching and learning activities	Assessment tasks*
1.	Students will be able to understand Identify the normal microflora present in different anatomical sites such as skin, throat, gastrointestinal tract, and urogenital tract.	Explain the concept of droplet nuclei and aerosols and their role in the transmission of diseases. Discuss preventive measures and control strategies to mitigate the spread of airborne diseases.	Quiz, class presentation and Assessment.

Unit no.	Course learning outcomes	Teaching and learning activities	Assessment tasks*
2.	Student will understand the symptoms, mode of transmission, prophylaxis, and control measures for diseases caused by Streptococcus pyogenes, H. influenzae, and Mycobacterium tuberculosis.	Focus on respiratory and gastrointestinal diseases caused by bacteria.	Class test focusing on short notes and assessment on soil microbes or bio fertilizers.
3.	Understand the concepts of Describe the symptoms, mode of transmission, prophylaxis, and control measures for diseases caused by Poliovirus, Herpesvirus, Hepatitis viruses, Rabies virus, Dengue virus, and Human Immunodeficiency Virus (HIV). Highlight the significance of viral and protozoan infections in public health.	Describe the processes of Highlight the significance of viral and protozoan infections in public health.	assessment of water quality using microbial indicators and potability criteria.
4.	Students will be able to Understand the principles of microbial bioremediation and its applications in environmental cleanup.	Explain the concepts of biodegradation, xenobiotics, bioaccumulation, and biopesticides in the context of microbiology.	Multiple choice questions and student presentations.
5.	Students will be able to understand the different methods of liquid waste treatment, including aerobic and anaerobic processes, primary, secondary, and tertiary treatments	Describe the processes of solid waste treatment, including saccharification, gasification, and composting.	Poster making, assessments, power point presentation

***Assessment tasks listed here are indicative and may vary.**

MAJOR CORE COURSE-II

3SFMC403: Microbiology –IV Food Microbiology

(Credits: theory-2, Practical-2)

Scheme of Examination

Course Code	Course Name	Credits	Maximum Marks Allotted						Duration of exam	
			Theory			Practical		Total	Theory	Practical
			End Sem	Mid Sem	Assign	End Sem	Term Sem			
3SFMC403	Food Microbiology	4(2+0+2)	60	20	20	60	40	200	3hr	2hr

Course Objectives

- To know the important genera of microorganisms associated with food and their characteristics.
- To understand the role of microbes in fermentation, spoilage and food borne diseases.

Course Learning Outcomes

- Understand the important genera of microorganisms associated with food and their characteristics, their growth pattern and parameters.
- Comprehend the role of the microorganisms in spoilage of foods and methods of their control.
- Knowledge about the beneficial role of microorganisms and different types of fermented foods.
- Identify the role of microorganisms in food borne diseases and control measures
- Understand the laboratory techniques to detect, quantify, and identify microorganisms in foods.

Syllabus Theory (2-0-2 Credits)

UNIT I

Introduction to Food Microbiology: History and Development of Food Microbiology Definition and Scope of food microbiology Inter-relationship of microbiology with other sciences.

UNIT -II

Characteristics of Microorganisms in Food: Types of microorganisms associated with food, their morphology and characteristics, Significance of spores in food microbiology. Microbial Growth in Food -Bacterial growth curve and factors affecting the growth of microorganisms in food.

UNIT -III

Microbial Food Spoilage and Food Preservation: Sources of Microorganisms in foods, some important food spoilage microorganisms. Spoilage of Specific Food Groups- milk and dairy products, meat, poultry and seafood, cereal and cereal products, fruits and vegetables and canned products. Control of Microorganisms in Foods -Principles and methods of preservation.

UNIT -IV

Food Fermentations: Fermentation –definition and types of Microorganisms used in food fermentations. Dairy Fermentations-starter cultures and their types, concept of probiotics Fermented Foods-types, methods of manufacture for vinegar, sauerkraut, tempeh, miso, soya sauce, yoghurt, beer, wine and traditional Indian foods.

UNIT -V

Food borne Diseases: Types – food borne infections, food borne intoxications and toxin-infections. Origin and symptoms of common food borne diseases and their preventive measures Recent outbreaks and emergence of pathogens.

Practical (Credits 2)

Introduction to the Basic Microbiology Laboratory Practices and Equipment

- Functioning and use of compound microscope
- Cleaning and sterilization of glassware
- Preparation and sterilization of nutrient broth
- Cultivation and sub-culturing of microbes
- Preparation of slant, stab and plates using nutrient agar
- Morphological study of bacteria and fungi using permanent slides
- Simple staining
- Gram's staining
- Standard Plate Count Method

Text book

- Frazier, William. C. and Westhoff, Dennis, C. (2004) Food Microbiology. New Delhi: Tata McGraw-Hill Education.
- Garbutt, J. (1997). Essentials of Food Microbiology. London: Arnold.
- Ray, B. and Bhunia, A. (2013) Fundamental Food Microbiology ,5th Edition. US: CRC Press.

Reference Book

1. "Food Microbiology: An Introduction" by Thomas J. Montville, Karl R. Matthews, Kalmia E. Kniel ASM Press Publication.

2. "Food Microbiology: Fundamentals and Frontiers" by Bhunia, A.K., Sharma, C.S., Singh, T.P.CRC Press Publication.

3. "Food Microbiology: Fundamentals and Frontiers" by Michael P. Doyle

ASM Press Publication.

4. "Essentials of Food Microbiology" by John Garbutt Springer Publication.

5. "Modern Food Microbiology" by James M. Jay, Martin J. Loessner, David A. Golden Publisher: Springer.

Facilitating the achievement of course learning objectives

Unit No.	Course Learning Outcomes	Teaching and Learning activities	Assessment tasks
1	Students will be acquainted with historical developments and scope of food microbiology.	Introduction to Food Microbiology. History and Development of Food Microbiology. Definition and Scope of food microbiology.	Quiz, Match the following, identification of food Scientists through Photographs.
2	Students will be aware of the important genera of microorganisms associated with food and their characteristics.	Characteristics of Microorganisms in food. Types of microorganisms associated with food, their morphology and structure. Significance of spores in food microbiology.	Multiple choice questions and presentations, Diagrammatic representations of structure of microorganisms

Unit No.	Course Learning Outcomes	Teaching and Learning activities	Assessment tasks
3	Students will have acquired in-depth knowledge of the important food spoilage microorganisms and spoilage of specific food groups.	Microbial Food Spoilage Sources of Microorganisms in foods. Some important food spoilage microorganisms. Spoilage of specific food groups- Milk and dairy products, Meat, poultry and seafood, Cereal and cereal products, Fruits and vegetables and Canned products.	Assignments Multiple choice questions and presentations.
4	Students will have gained knowledge on the beneficial role of microorganisms in fermented foods and in food processing.	Food Fermentations Fermentation –definition and types Microorganisms used in food fermentations Dairy Fermentations-starter cultures and their types, concept of probiotics, Fermented Foods-types, methods of manufacture for vinegar, sauerkraut, tempeh, miso, soya sauce, beer, wine and traditional Indian foods	Student presentations, Quiz, Match the following
5	Students will be acquainted with harmful role of microorganisms in food as pathogens	Food borne Diseases Types – food borne infections, food borne intoxications and toxin infections. Common and Recent Examples	Class tests focusing on short notes.

***Assessment tasks listed here are indicative and may vary.**

MINOR CORE COURS

3SSDM404: Botany-IV (Structure, Development and Reproduction in Flowering Plant)
(Credits: theory-4, Practical-2)

Scheme of Examination

Course Code	Course Name	Credits	Maximum Marks Allotted						Duration of exam	
			Theory			Practical				
			End Sem	Mid Sem	Assign	End Sem	Term Sem	Total	Theory	Practical
3SSDM404	Botany-IV Structure, Development & Reproduction in Flowering Plant	6(4+0+2)	60	20	20	60	40	200	3hr	2hr

Course Objectives

- The anatomy of a flower.
- The life cycle of flowering seed plants the anatomy of a seed.
- The role of pollination and seed dispersal in the angiosperm life cycle.
- Identify the characteristics of flowering plants.
- Describe the structure of a flower and the difference between perfect and imperfect flowers.
- Summarize the life cycle of a flowering plant, identifying the sporophyte, the gametophytes, and when mitosis and meiosis fertilization.

Course Learning Outcomes

- Understand the anatomical features of roots, stems, leaves, and flowers in flowering plants.
- Identify and describe the different reproductive structures in flowering plants, including flowers, fruits, and seeds.
- Comprehend the life cycle of flowering plants, focusing on stages from germination through flowering to seed development.
- Explore the cellular and molecular processes involved in plant growth, development, and reproduction.
- Explain the processes of fertilization in flowering plants, covering both self-pollination and cross-pollination.

Syllabus **Credits: 4-0-2**

UNIT – I

The Root System: Root apical meristems, differentiation of primary and secondary tissues and their roles. Anatomy of monocot and dicot roots. Morphological modification of root for storage. Respiration. Interaction of root with microbes.

UNIT – II

The Shoot System: Shoot apical meristem and histological organization. Anatomy of Monocot and Dicot Stem. Vascular cambium and its functions. Secondary growth in stem, characteristics of growth rings: sapwood and heart wood. Secondary Phloem, Cork Cambium and Periderm. Anatomy of C_3 and C_4 Plants Anomalous Secondary growth in *Nyctanthus*, *Boerhhavia*, *Achyranthus*, *Leptadenia*, *Salvadora*, *Bignonia* and *Dracaena.*

UNIT – III

The Leaf System: Origin and development of leaf. Diversity in size, shape and arrangement. Internal structure of Dicot and Monocot leaf. Adaptations to photosynthesis and water stress. Senescence and abscission.

UNIT – IV

The Flower System: Concept of flower as a modified shoot. Structure of anther, Microsporogenesis and Male Gametophyte. Structure of pistil, Ovules, Megasporogenesis and Development of Female Gametophyte (Embryo Sac) and its types. Pollination – Mechanism and agencies of pollination, Pollen pistil interactions and self-incompatibility.

UNIT – V

Embryology: Double fertilization and triple fusion. Development and types of endosperms and its morphological nature, Development of Embryo in Monocots and Dicot plants. Polyembryony and Apomixis, Application of Palynology Experimental Embryology including pollen storage and test tube fertilization. Fruit development and maturation, seed structure and dispersal, Vegetative propagation.

Practical Content **Credits :2**

- Study of anatomy of t. s. of dicot root *helianthus* annus.
- Study of anatomy of t. s. of dicot root *Cicer* and *ranunculus*.
- Study of anatomy of t. s. of monocot roots *asparagus*.
- Study of anatomy of t. s. of monocot roots *zea mays* and *orchid*.
- Study of anatomy of t. s. of dicot stem *Cucurbita* and *xanthium*.
- Study of anatomy of t. s. of monocot stem *Triticum aestivum* and *asparagus*.
- Study of v. s. of isobilateral monocot leaf *Zea mays* and *bambusa*.
- Study of prepared slide of l. s. of shoot apex.
- Study of prepared slide of l. s. of root apex.
- Study of different types of ovules.
- Study of pneumatophore or respiratory root.

Reference Book

- Plant Physiology by - Lincoln Taiz and Eduardo Zeiger.
- Plant Development and Evolution by- Quentin Cronk and Richard M. Bateman.
- Botany: An Introduction to Plant Biology by- J. D. Mauseth.
- Plant Reproduction by- Shashi. Kumar.
- Reproductive Biology of Plants by- K.R. Shivanna and V.K. Sawhney.

Text Book

- Structure Development and Reproduction in Flowering Plants - Arun. K. Pandey.
- A Text Book of Botany- Structure Development and Reproduction in Angiosperm –V. Singh.
- Anatomy of Flowering Plants- Paula. J. Rudall.

MINOR CORE COURS

3SPOM404: Chemistry-IV (Physical, Organic and Inorganic Chemistry)

(Credits: Theory-4, Practical-2)

Scheme of Examination

Course Code	Course Name	Credits	Maximum Marks Allotted						Duration of exam	
			Theory			Practical				
			End Sem	Mid Sem	Assign	End Sem	Term Sem	Total	Theory	Practical
3SPOM404	Chemistry-IV (Physical Organic and Inorganic Chemistry)	6(4-0-2)	60	20	20	60	40	200	3 hr	2 hr

Course Objectives

- Understand phase compositions and eutectic systems.
- Grasp ideal and non-ideal liquid behavior.
- Learn electrical transport and concentration cells.
- Understand electronic structure and chemistry.
- Learn about aldehydes, ketones, and nitrogen compounds.

Course Learning Outcomes

- Identify phases and understand eutectic systems.
- Comprehend ideal and non-ideal behavior.
- Understand conductivity and concentration cells.
- Recognize electronic structures and chemistry.
- Learn synthesis and reactions of functional groups.

Syllabus

Credits 4-0-2

Physical Chemistry

UNIT – I

Phase Equilibrium

Statement and the meaning of the terms: Phase component and the degree of freedom, derivation of the Gibbs phase rule. Simple eutectic System: Bi-Cd, Pb-Ag system. Desiliverisation of lead. One component system: Water, CO_2 and S system. Two component system: Solid liquid equilibria.

Solid Solutions

Systems in which compound formation with congruent melting point (Mg-Zn) and incongruent melting point, (NaCl-H_2O) and ($CuSO_4$-H_2O) system. Freezing mixtures: Acetone-dry ice.

UNIT – II

Electrochemistry

Electrical transport, conduction in metals and in electrolyte solutions. Specific conductance and equivalent conductivity, measurement of equivalent conductance, migration of ions and Kohlrausch law, Arrhenius theory of electrolyte dissociation and its limitations. Weak and strong electrolytes, Ostwald's dilution law, its uses and limitations. Theory of strong electrolytes. Transport number: Definition and determination by Hittorf method and moving boundary method.

Inorganic Chemistry

UNIT – III

Chemistry of Lanthanides Elements

Electronic structure, oxidation states, ionic radii and lanthanide contraction, complex formation, occurrence and isolation of lanthanide compounds.

Chemistry of Actinides

General features and chemistry of actinides, chemistry of separation of Np, Pu and Am from U, similarities between the later actinides and later lanthanides.

Organic Chemistry

UNIT – IV

Aldehydes and ketones

Nomenclature and structure of the carbonyl group. Synthesis of aldehydes and ketones with particular reference to the synthesis of aldehydes from acid chlorides, synthesis of aldehydes and ketones using 1,3-dithianes, synthesis of ketones from nitriles and from carboxylic acids, physical properties. Mechanism of nucleophilic additions to carbonyl group with particular emphasis on benzoin, Aldol, Perkin and Knoevenagel condensations. Condensation with ammonia and its derivatives. Wittig reaction, Mannich reaction. Use of acetals as protecting group, Oxidation of aldehydes, Baeyer-Villager oxidation of ketones, Cannizzaro reaction.

UNIT – V

Organic Compounds of Nitrogen

Preparation of nitro alkanes and nitroarenes. Chemical reaction of nitro alkanes. Mechanism of nucleophilic substitution in nitroarenes and their reductions in acidic, neutral and alkaline media.

Halo nitroarenes

Reactivity, structure and nomenclature of amines, physical properties, stereochemistry of amines, separation of mixture of primary, secondary and tertiary amines. Structural features affecting basicity of amines. Amine salt as phase transfer catalysts. Preparation of alkyl and aryl amines (reduction of nitro compounds, nitriles), reductive amination of aldehydic and ketonic compounds. Gabriel-Phthalimide reaction, Hoffmann bromamide reaction.

Practical Content — Credits: 2

Physical Chemistry

- To study the effect of solute (e.g., NaCl, succinic acid) on the critical solution temperature of two partially miscible liquids (e.g., phenol water system) and to determine the concentration of that soluble in phenol water system.
- To construct the phase diagram of two components (e.g., diphenyl amine benzophenone) by cooling curve method.
- To determine the enthalpy of neutralization of weak acid/weak base versus strong acid/ strong base and determine the enthalpy of ionization of the weak acid/ base.

Inorganic chemistry

- Estimation of ferrous and ferric by dichromate method.
- Estimation of copper using thiosulphate.

Organic Chemistry

- Identification of an organic compound through the functional group analysis, determination of melting point and preparation of suitable derivatives.

Text Books

- Unified Chemistry by Tandon, Rathore & Agarwal.
- Physical Chemistry by P. W. Atkins and Julio de Paula.
- Inorganic Chemistry by Gary L. Miessler and Paul J. Fischer.
- Organic Chemistry by Jonathan Clayden, Nick Greeves, and Stuart Warren.
- Electrochemistry by Philip N. Bartlett.
- Phase Equilibria in Chemical Engineering by Stanley M. Walas.

Reference Books

- Electrochemical Methods: Fundamentals and Applications by Allen J. Bard and Larry R. Faulkner.
- Principles of Phase Equilibria and Phase Diagrams by C. H. P. Lupis.
- Inorganic Chemistry by Catherine Housecraft and Alan G. Sharpe.
- Organic Synthesis by Michael B. Smith.
- Handbook of Lanthanide and Actinide Chemistry by Simon Cotton.

Facilitating the achievement of course learning objectives

Unit No.	Course Learning Outcome	Teaching and Learning Activities	Assessment Tasks
1	Define and differentiate between phases, such as solid, liquid, and gas, and explain the fundamental principles governing phase transitions.	Provide foundational knowledge through lectures on topics like phase diagrams, phase transitions, Gibbs phase rule, chemical potential, and thermodynamic equilibrium.	Class test focusing on short questions.
2	The fundamental principles of electrochemistry, including the laws governing electrical transport, Faraday's laws, and the Nernst equation.	Conduct laboratory sessions where students perform electrochemical experiments, such as measuring cell potentials, conducting cyclic voltammetry, or investigating corrosion processes.	Class test focusing on definitions and short questions.
3	Analyse and identify alkanes and nitroarenes. Synthetic transformation of aryl diazonium salts, Azo coupling.	Traditional lectures can introduce students to the fundamental concepts of alkanes and nitroarenes, including their structures, nomenclature, and basic properties.	Class test focusing on long questions.
4	Identification and differentiate between lanthanide elements in the periodic table, recognizing their atomic numbers and electron configurations.	Encourage active participation through Qand A sessions and open discussions on lanthanide properties and trends.	Class test focusing on definitions and short and long questions.

Unit No.	Course Learning Outcome	Teaching and Learning Activities	Assessment Tasks
5	The reactions specific to aldehydes and ketones, including nucleophilic addition reactions, reduction, oxidation, and formation of hemiacetals and acetals.	Conduct lectures to introduce key concepts related to aldehydes and ketones, including nomenclature, reactivity, and synthesis.	Class test focusing on and short and long questions.

ABILITY ENHANCEMENT COURSE (AEC)

3HCHA401: Cultural Heritage

(Credit: Theory -2 Tutorial - 0)

Scheme of Examination

Course Code	Course Name	Credit	Maximum marks Allotted						Duration of Exam.	
			Theory			Practical		Total	Theory	Practical
			End Sem	Mid Sem	Assign	End Sem	Term Sem			
3HCHA401	Cultural Heritage	2(2-0-0)	60	20	20	-	-	100	2 hr	-

Course Objective

- The primary objective of this course is to explore the significance, evolution, and preservation of culture and heritage across different societies and time periods.
- Students will gain a deeper understanding of how culture and heritage shape identities, influence societies, and contribute to a sense of belonging.

Course Outcomes

- Upon completion of this course, students will have a comprehensive understanding of culture and heritage, their significance in society, and the various challenges and methods associated with their preservation.
- They will develop critical thinking skills to evaluate cultural issues and contribute to the sustainable management of cultural heritage.

Syllabus **(Credit – 2)**

Unit 1: Introduction to Culture and Heritage

- Definition of culture and heritage
- Importance of studying culture and heritage
- Overview of key concepts and terms (e.g., cultural diversity, cultural identity, intangible cultural heritage)

Unit 2: Cultural Expressions and Artifacts

- Exploration of various forms of cultural expressions (e.g., music, dance, visual arts, literature, traditional crafts)
- Analysis of the role of cultural expressions in preserving and transmitting heritage
- Case studies of significant cultural artifacts and their historical and cultural significance

Unit 3: UNESCO World Heritage Sites

- Introduction to UNESCO and its World Heritage program
- Study of selected UNESCO World Heritage Sites from different regions
- Analysis of the criteria for selection and the challenges faced in preserving and protecting these sites

Unit 4: Cultural Identity and Cultural Heritage

- Examination of the relationship between cultural identity and cultural heritage
- Discussion on the ways in which cultural heritage shapes individual and collective identities
- Impact of globalization and cultural assimilation on cultural identity and heritage preservation

Unit 5: UNESCO World Heritage Sites

- Introduction to UNESCO and its World Heritage program
- Study of selected UNESCO World Heritage Sites from different regions
- Analysis of the criteria for selection and the challenges faced in preserving and protecting these sites

Reference Books

- Bhartiya Kala avm Sanskriti - Nitin Singhania- ISBN -13:978-9354601842
- Bharti Sanskriti Kala avm virast – devdat patnayak –- ISBN. -13:978-935440095
- Madhukar Kumar Bhagat –II Adition, ISBN-13:9789389310382
- Bhartiya Kala avm Sanskriti awam virasat – ISBN-13:978-9388182577 Minakshi Kant
- Vishy vikhyat bhartiya kala or sanskriti virasat – ISBN- 9789381395462, Rama shyal

Facilitating the Achievement of Course Learning Objectives

Unit no.	Course Learning Objectives	Course Learning Outcomes	Teaching and Learning Activities	Assessment Tasks
Unit 1: Introduction to Culture and Heritage	● Define culture and heritage. ● Explain the importance of studying culture and heritage. ● Familiarize students with key concepts and terms related to culture and heritage (e.g., cultural diversity, cultural identity, intangible cultural heritage).	● Students will be able to define culture and heritage. ● Students will understand the significance of studying culture and heritage. ● Students will demonstrate knowledge of key concepts related to culture and heritage.	● Lectures and discussions on the definition and importance of culture and heritage. ● Reading assignments and case studies to explore key concepts. ● Group discussions and presentations on cultural diversity and identity.	● Class participation and engagement in discussions. ● Written assignments or quizzes on key concepts. ● Group presentations on cultural diversity and identity.
Unit 2: Cultural Expressions and Artifacts	● Explore various forms of cultural expressions such as music, dance, visual arts, literature, and literature, and traditional crafts. Analyze the role of cultural expressions in preserving and transmitting heritage	● Students will be able to identify different forms of cultural expressions. ● Students will understand the importance of cultural expressions in heritage preservation. Students will analyze the historical and cultural significance of selected artifacts.	● Practical sessions or workshops on various cultural expressions (e.g., music and dance workshops, art exhibitions). ● Case study analysis and group discussions on the role of cultural expressions in heritage preservation. ● Research assignments on selected cultural artifacts and their significance.	● Presentation or demonstration of a chosen cultural expression. ● Written analysis of the role of cultural expressions in heritage preservation. ● Research paper or presentation on a selected cultural artifact and its significance

Unit no.	Course Learning Objectives	Course Learning Outcomes	Teaching and Learning Activities	Assessment Tasks
Unit 3: UNESCO World Heritage Sites	● Introduce students to UNESCO and its World Heritage program. ● Study selected UNESCO World Heritage Sites from different regions. ● Analyze the criteria for selection and the challenges faced in preserving and protecting these sites.	● Students will understand the role of UNESCO in preserving cultural and natural heritage. ● Students will gain knowledge of specific UNESCO World Heritage Sites and their cultural importance ● Students will analyze the criteria used for selecting World Heritage Sites and the preservation challenges they face.	● Lectures and presentations on UNESCO and the World Heritage program. ● Virtual or physical tours of selected UNESCO World Heritage Sites. ● Discussions on the criteria for World Heritage Site selection and the preservation challenges they pose.	● Research project or presentation on a specific UNESCO World Heritage Site. ● Essay or report on the criteria for selecting World Heritage Sites and the challenges they face in preservation
Unit 4 Cultural Identity and Cultural Heritage	● Examination of the relationship between cultural identity and cultural heritage Discussion on the ways in which cultural heritage shapes individual and collective identities Impact of globalization and cultural assimilation on cultural identity and heritage preservation	● Students will be able to: Analyze the relationship between cultural identity and cultural heritage Evaluate the impact of cultural heritage on individual and collective identities Assess the impact of globalization and cultural assimilation on cultural identity and heritage preservation	● Lectures and presentations on cultural identity and cultural heritage Group discussions and debates on the impact of cultural heritage on individual and collective identities Case studies on the impact of globalization and cultural assimilation on cultural identity and heritage preservation	● Written assignments on the analysis of the relationship between cultural identity and cultural heritage Oral presentations on the impact of cultural heritage on individual and collective identities Case study analysis on the impact of globalization and cultural assimilation on cultural identity and heritage preservation
Unit 5 Cultural Identity and Cultural Heritage	● Introduction to UNESCO and its World Heritage program Study of selected UNESCO World Heritage Sites from different regions Analysis of the criteria for selection and the challenges faced in preserving and protecting these sites	● Students will be able to: Understand the importance of UNESCO World Heritage sites Analyze the criteria for selection of World Heritage sites Evaluate the challenges faced in preserving and protecting World Heritage sites	● Lectures and presentations on UNESCO and World Heritage sites Group discussions and debates on the criteria for selection and challenges faced in preserving and protecting World Heritage sites Field trips to selected World Heritage sites	● Written assignments on the analysis of the criteria for selection and challenges faced in preserving and protecting World Heritage sites Oral presentations on the importance of UNESCO World Heritage sites Group projects on the preservation and protection of World Heritage site.

RAMANUJAN SCHOOL OF SCIENCE

BACHLOR OF SCIENCE

(Microbiology)

(B. Sc. (Microbiology) – CKUG04C03)

V Semester

MAJOR CORE COURSE-I

3SIAC503: Microbiology-V (Industrial and Agriculture Microbiology)

(Credits: Theory-4 Practical-2)

Scheme of Examination

Course Code	Course Name	Credits	Maximum Marks Allotted						Duration of exam	
			Theory			Practical				
			End Sem	Mid Sem	Assign	End Sem	Term Sem	Total	Theory	Practical
3SIAC503	Microbiology-V (Industrial and Agriculture Microbiology)	6(4+0+2)	60	20	20	60	40	200	3hr	2hr

Course Objective

- Industrial microorganisms are used to produce many things, including food, cosmetics, pharmaceuticals, and construction materials.
- Microorganisms can be genetically modified or engineered to aid in large-scale production.

Course Outcomes

- Industrial microbiology includes the use of microorganisms to manufacture food or industrial products in large quantities.
- Numerous microorganisms are used within industrial and agriculture microbiology;

Syllabus: Theory (Credits 4-0-2)

UNIT – I

Fermentation Equipment's and production process. Principles types of fermenters- the batch fermenters, continuous stirred tank fermenters, Tubular fermenter, The fluidized bed fermenter, Solid State fermenters. Computer control of fermentation process. Strain improvement process.

UNIT – II

Industrial production of organic acids- Lactic and Enzymes - amylase, protease and amino acids. Production of alcohol, wine, beer and acetic acid. Production of antibiotics - Penicillin and Streptomycin.

UNIT – III

Nature of soil - Soil as microenvironment, Soil organic matters and humus, Soil and surface environment, Soil pores and movement of gases for microbial activity, Microbes in soil surface and different zones of soil. Decomposition of Plant and animal residues by microorganisms in soil. Soil management. Management practices: Pesticides and their impact and effect on soil fertility.

UNIT – IV

Microbial diseases of crop plants. Control of plant diseases. Chemical control of plant diseases. Biological Control- its mechanism and importance, biopesticides. Brief account of microbial interaction: Symbiosis, neutralism, Commensalism, Competition, Ammensalism, Synergism, Parasitism.

UNIT – V

Importance of microorganisms in dairy industries. Production of cheese, Butter milk and in bakery industries - leavening of bread, Indian fermented foods. Fungi and bacteria as a source of single cell proteins (SCP) and proteins.

Practical's (Credits 2)

- Measurement of production of citric acid by Aspergillus Niger.
- Measurement and production of alcohol by yeast.
- Demonstration of Transformation of steroids.
- Demonstration of IAA production by microbes.
- Demonstration of enzyme production by microorganisms.
- Study of microbial diseases of crop plants.
- Study of effect of fungicides and insecticides on microorganisms

Textbook

1. A Text Book of Microbiology by D. K. Maheshwari.
2. Microbiology book by Michael J. Pelzer and L.C.S. chain.
3. Text book of microbiology by C.P. Baweja.
4. A text book of microbiology by Anantha Narayan and Paniker's.

Reference Book

1. "Bioprocess Engineering: Basic Concepts" by Michael L. Shuler, Fikret Kargi, Prentice Hall Publication.

2. "Industrial Microbiology: An Introduction" by Michael J. Waites, Neil L. Morgan, John S. Rockey, Gary Higton Wiley-Blackwell Publication.

3. "Soil Microbiology, Ecology and Biochemistry" by Eldor A. Paul Academic Press Publication.

4. "Plant Pathology" by George N. Agrios Academic Press Publication.

5. "Dairy Microbiology: A Practical Approach" by R.K. Robinson, C.A. Batt, P.D. Patel CRC Press Publication.

Facilitating the achievement of course learning objectives

Unit no.	Course outcomes	Teaching and learning activities	Assessment tools
1	Students will be Understand the principles of fermentation and the essential equipment used in the production process. the methods and importance of strain improvement in microbial fermentation.	Differentiate between various types of fermenters, including batch, continuous stirred tank, tubular, fluidized bed, and solid-state fermenters.	Quiz, multiple choice questions.
2	Students will acquire in-depth knowledge of the microbial fermentation processes involved in the production of these organic compounds.	Explain the industrial production processes for organic acids, such as lactic acid, and enzymes like amylase, protease, and amino acids.	Fill up questions, true-false, flowcharts, multiple choice questions.
3	Students will have acquired detailed knowledge about the microbial processes involved in the production of alcohol, wine, beer, and acetic acid. Understand the principles of soil fertility and its management, including the influence of available nitrogen and the importance of crop rotation.	Explain the industrial production of antibiotics, specifically Penicillin and Streptomycin. Discuss soil management practices, including the impact of pesticides on soil fertility.	Quiz, Student presentations.

Unit no.	Course outcomes	Teaching and learning activities	Assessment tools
4	Understand the concept of bio pesticides and their role in sustainable pest management.	Explain methods for controlling plant diseases, including chemical and biological control strategies.	Quiz and multiple-choice questions.
5.	Understand the concept of single-cell proteins (SCP) and their potential as a protein source derived from fungi and bacteria.	Theory class on the significance of micro-organisms in dairy and bakery industries, including their roles in cheese production, bread leavening, and Indian fermented foods.	practical test, quiz, multiple choice questions.

*** Assessment tasks listed here are indicative and may vary.**

MAJOR CORE COURSES - II

3SMGC503: Microbiology-V (Microbial Genetics)

(Credits: Theory-2 Practical-2)

Scheme of Examination

Course Code	Course Name	Credits	Maximum Marks Allotted						Duration of exam	
			Theory			Practical				
			End Sem	Mid Sem	Assign	End Sem	Term Sem	Total	Theory	Practical
3SMGC503	Microbiology-V (Microbial Genetics)	4(2+0+2)	60	20	20	60	40	200	3hr	2hr

Course Objective

1. Students will learn the basic principles of inheritance at the molecular, cellular and organismal levels.
2. Students will understand causal relationships between molecule/cell level phenomena ("modern" genetics) and organism-level patterns of heredity ("classical" genetics)
3. Students will test and deepen their mastery of genetics by applying this knowledge in a variety of problem-solving situations.
4. Recombinant DNA methods and their basis in bacterial genetics.
5. Applications of DNA technology: pharmaceuticals, agriculture.

Course Outcome

The student will demonstrate knowledge of gene manipulation and analysis by:

- Describing the processes and applications of Recombinant DNA Technology.
- Explaining the role of restriction end nucleases in gene manipulation.
- Determining the applicability of different kinds of cloning vectors.
- Illustrating the use of genomic libraries in gene detection and characterization.
- Examining the process of restriction mapping.
- Describing the process of Southern Blot analysis.
- Summarizing methods used for DNA sequencing.
- Describing the principles of the Polymerase Chain Reaction (PCR) and their applications.

Syllabus: Theory (Credits 2-0-2)

UNIT - I

Fundamentals of Genetics, DNA as genetic material, Structure and types of DNA and RNA, Genetic code, Protein synthesis - Transcription and translation.

UNIT - II

DNA Replication and Gene Structure, DNA replication. Fine structure analysis of r II region of T4 by Benzer.

UNIT - III

Mutation; Evidence for spontaneous nature of mutation. Molecular basis of mutation- Types of mutation. Types of bacterial mutants and their isolation.

UNIT - IV

Genetic Recombination- I

Gene transfer in bacteria, Transformation- Competence, DNA uptake, artificially induced competence, electroporation, Transposable elements, Plasmid- Structure, properties and types of plasmids.

UNIT – V

Genetic Recombination –II Transduction- U tube experiment, Generalized and specialized transduction, Abortive transduction, Conjugation- F factor, characters of donor and recipient, Steps in conjugation, transformation, transduction, formation of Hfr and F prime cells.

Practical's (Credits 2)

- Isolation of bacterial genomic DNA.
- Isolation of Plasmid DNA.
- Electrophoretic analysis of DNA.
- UV as a mutagenic agent.
- Replica plating technique.
- Isolation of antibiotic-resistant mutants by gradient plate technique.
- Quantitative estimation of DNA by DPA method.
- Quantitative estimation of RNA by original method

Textbook

1. A Text Book of Microbiology by D. K. Maheshwari.
2. Microbiology book by Michael J. Pelczar and L.C.S. chain.
3. Text book of microbiology by C.P. Baweja.
4. A text book of microbiology by Anantha Narayan and Paniker's.

Reference Book

1. "Genetics: Analysis and Principles" by Robert J. Brooker (Publisher: McGraw-Hill Education).
2. "Molecular Biology of the Gene" by James D. Watson, Tania A. Baker, Stephen P. Bell, Alexander Gann, Michael Levine, and Richard Losick (Publisher: Pearson).
3. "Principles of Genetics" by D. Peter Snustad and Michael J. Simmons (Publisher: Wiley).

Facilitating the achievement of course learning objectives

Unit No.	Course learning outcomes	Teaching and learning activities	Assessment tasks
1.	Understand the historical experiments and evidence supporting DNA as the genetic material.	Differentiate between different types of RNA, such as mRNA, tRNA, and rRNA, and their roles in protein synthesis.	Multiple choice questions, short notes.
2.	Understand the process of DNA replication, including the role of DNA polymerase and the replication fork.	Describe concept of fine structure analysis and its significance in mapping genes within a genetic locus.	Multiple choice questions, short notes.
3.	Understand the molecular basis of mutation and various types of mutations, including point mutations, insertions, deletions, and frameshift mutations.	Explain how mutation is a natural process contributing to genetic diversity.	Short & long tests, application-based test and Projects.

Unit No.	Course learning outcomes	Teaching and learning activities	Assessment tasks
4.	Understand the mechanisms of transposition and the impact of transposable elements on genome structure and evolution.	Describe the structure and properties of plasmids, including their circular DNA nature and self-replicating capability.	Short & long tests, application-based test and projects.
5.	Understand the formation of Hfr (high-frequency recombination) and F prime cells and their significance in genetic recombination.	Describe the process of conjugation and its role in genetic exchange between bacterial cells.	Short and long tests, application-based tests.

***Assessment tasks listed here are indicative and may vary.**

MAJOR CORE COURSES - III

3SMPC503: Microbiology-V (Microbial Physiology)

(Credits: Theory-2 Practical-2)

Scheme of Examination

Course Code	Course Name	Credits	Maximum Marks Allotted						Duration of exam	
			Theory			Practical		Total	Theory	Practical
			End Sem	Mid Sem	Assign	End Sem	Term Sem			
3SMPC503	Microbiology-V (Microbial Physiology)	4(2+0+2)	60	20	20	60	40	200	3hr	2hr

Course Objective

- Microbial physiology is a broad subject area and this course will attempt to provide a balance between the breadth of subjects addressed and the depth at which the subjects are discussed.
- The introductory lectures will address metabolic functions that are common to most organisms. The lectures will then progress to address metabolic functions that are the "exception to rule" to highlight the diversity of the microbial world.
- Students will learn about current events in the subject of microbial physiology and modern techniques used to examine metabolism. They will also learn about how the metabolic potential of micro-organisms has been harnessed to address problems facing society.

Course Outcome

- Demonstrate theory and practical skills in microscopy and their handling techniques and staining procedures.
- Understand the basic microbial structure and function and study the comparative characteristics of prokaryotes and eukaryotes and also Understand the structural similarities and differences among various physiological groups of bacteria/archaea.
- Know various Culture media and their applications and also understand various physical and chemical means of sterilization.
- Know General bacteriology and microbial techniques for isolation of pure cultures of bacteria, fungi and algae.
- Understand the microbial transport systems and the modes and mechanisms of energy conservation in microbial metabolism – Autotrophy and heterotrophy.
- Know the various Physical and Chemical growth requirements of bacteria and get equipped with various methods of bacterial growth measurement.

Syllabus: Theory Credits 2(2-0-2)

UNIT - I

Cultivation and Pure Culture Techniques, Nutrition and nutritional types of bacteria, Bacteriological media (types and uses), cultivation of aerobic and anaerobic microbes, Isolation of microorganisms, pure culture and cultural characteristics.

UNIT - II

Microbial Growth Mathematical expression of bacterial growth, generation time and growth rate, Growth curve and phases of growth cycle, Batch, continuous and synchronous cultures; diauxic growth. Factors affecting microbial growth.

UNIT - III

Measurement and Preservation Methods, Quantitative measurement of bacterial growth by cell mass, cell number and cell activity. Maintenance and preservation of cultures.

UNIT - IV

Control of Microorganisms- I

Microbial death curve under adverse condition. Concept of sterilization, disinfection, Asepsis and sanitation. Physical methods of control- Temperature, radiation, desiccation, osmotic pressure, filtration.

UNIT - V

Control of Microorganisms-II

Chemical methods of control- Phenol, alcohol, halogens, heavy metals, dyes, detergents, quaternary ammonium compounds, Aldehydes and gaseous chemo sterilizers. Evaluation of antimicrobial potency of disinfectants and antiseptics- Tube dilution, Agar diffusion. Phenol coefficient.

Practical's: - (Credits 2)

1. Principles and working knowledge of instruments like autoclave, pH meter, incubator, hot air.
2. Hot air oven, centrifuge, microscope and colony counter.
3. Preparation of solid and liquid culture media and their sterilization.
4. Growth of bacteria on agar slant, agar stab, Petri plate and in broth.
5. Staining techniques- Simple staining, Gram staining, Negative staining, Endospore staining, Metachromatic granule staining, Spirochete staining.
6. Isolation of microorganisms by streak plate method.
7. Isolation of microorganisms by pour plate method.
8. Preparation of McFarland scale.
9. Use of counting chamber for bacterial count.
10. Effect of temperature on bacterial growth.
11. Effect of pH on bacterial growth.
12. Effect of osmotic pressure (salt and sugar concentration) on bacterial growth.

Textbook

1. A Text Book of Microbiology by D. K. Maheshwari.
2. Microbiology book by Michael J. pelczar and L.C.S. chain.
3. Text book of microbiology by C.P. Bawaja.
4. A text book of microbiology by Anantha Narayan and paniker's.

Reference Book

1. "Microbiology: Principles and Explorations" by Jacquelyn G. Black (Publisher: John Wiley & Sons).
2. "Brock Biology of Microorganisms" by Michael T. Madigan, Kelly S. Bender, Daniel H. Buckley, W. Matthew Sattley (Publisher: Pearson).
3. "Laboratory Applications in Microbiology: A Case Study Approach" by Barry Chess (Publisher: McGraw-Hill Education).
4. "Microbiology: A Systems Approach" by Marjorie Kelly Cowan (Publisher: McGraw-Hill Education).
5. "Prescott's Microbiology" by Joanne Willey, Linda Sherwood, Christopher J. Woolverton (Publisher: McGraw-Hill Education).

Facilitating the achievement of course learning objectives

Unit No.	Course learning outcomes	Teaching and learning activities	Assessment tasks
1.	Students will understand the different types of bacteriological media and their specific applications for cultivating microbes.	Discussion on demonstrate the ability to isolate microorganisms, establish pure cultures, and recognize cultural characteristics.	Multiple choice questions, short notes.
2.	Students will be able to explain the growth curve and identify the various phases of the growth cycle.	mathematically express bacterial growth, including concepts like generation time and growth rate.	Multiple choice questions, short notes, application on product development.
3.	Students will be proficient in the maintenance and preservation of microbial cultures.	Discussion on the knowledge and skills to quantitatively measure bacterial growth using methods such as cell mass, cell number, and cell activity.	Short & long tests, application-based test and Projects.
4.	Students will understand and apply physical methods of microbial control, including temperature, radiation, desiccation, osmotic pressure, and filtration.	Discuss on grasp the concepts related to sterilization, disinfection, asepsis, and sanitation.	Short and long tests, application-based test.
5.	Students will understand the steps involved in bacterial genetic processes like conjugation and the formation of Hfr and F prime cells.	Theory class on demonstrate the ability to assess the antimicrobial potency of disinfectants and antiseptics using methods like tube dilution, agar diffusion, and the phenol coefficient.	Short & long tests, application-based tests.

***Assessment tasks listed here are indicative and may vary.**

MINOR CORE COURSE

3SIBM504: Botany-V (Industrial Botany)

(Credits: Theory-2 Practical-2)

Scheme of Examination

Course Code	Course Name	Credits	Maximum Marks Allotted						Duration of exam	
			Theory			Practical				
			End Sem	Mid Sem	Assign	End Sem	Term Sem	Total	Theory	Practical
3SIBM504	Botany –V (Industrial Botany)	4(2+0+2)	60	20	20	60	40	200	3hr	2hr

Course Objectives

- This course will provide knowledge on plants and their parts used in various industries.
- Students will get an idea to establish plants based natural product industry.
- This course will make the students self-reliant.
- Understand the historical development and significances of industrial botany in modern agriculture and industries.

Course Learning Outcomes

- Students will know about concept of diseases, knowledge and awareness of diseases, causal agents of plant diseases, identification methods and management of crop diseases.
- Students will understand the historical development and significance of industrial botany in agriculture and various industries
- Ability to articulate and apply fundamental terminology and concepts in industrial botany.
- Demonstrate a comprehensive understanding of plant physiological processes and their practical applications in industrial crop production.
- Apply knowledge to analyze and solve problems related to plant physiology in an industrial context.

Syllabus **Credits: 2:0:2**

UNIT-I

Plant in Timber Industry: Timber yielding trees of India, - Importance of timber or products of timber structure of wood porous and non-porous of wood, Physical Properties of wood preservation, Types of wood and their products. (*Shisham*, *Sal*, *Teak*, *Deodar*, *Babool*) Bamboo and cane industry-Bamboos in India properties of bamboo cultivation, Utilization of bamboo.

Kattha Industry- Industry profile and market opportunities manufacturing process raw material availability advantages and disadvantages of *Kattha*.

UNIT-II

Leaf Based Industries: Utility products of leaf- Botanical characters and use (*Palash*, Banana).

Tea Industry-Origin, distribution botanical characters, cultivation processing of tea production, others types of tea, special types of Indian tea.

Leaf oil Industry- Essential or volaille oils (Mint, Camphor, *Neem*, *Tulsi*, Eucalyptus and Lemon grass).

Leaves used as spices-Cultivation of different types of leaves (*Kasoori Methi*, *Pudina, curry patta*, onion, *tejpatta*)

UNIT-III

Flower Based Industries: Perfume products of flowers – Perfume industry of India rose- Characters importance of rose extraction of rose oil and uses Jasmine. - Characters, Cultivation, Extraction of jasmine oil. Heena - Characters, Cultivation, making of henna oil, and uses.

Colour Industry- Aims of food coloring history and types of food colours side effects of artificial food colours food colour industry of India. Holi colours – preparation of natural colours of holi, Holi colour industry of India.

Raw material for fermentation- Fermentation types of fermentation types of fermentation *Mahua- mahua* as a raw material for fermentation, fermentation process of *mahua* flowers and uses of *mahua*.

UNIT-IV

Fruits and Seed Based Industries: Preparation and methods - Jams, Jellies, Juice, Souce and Pickles and scope of business of fruit and vegetable.

Poha and *Daal* Industries- *Poha* industry production technique of *poha*, Processing methods of flaked rice. health benefits of *poha*: *Poha* industry in MP. *Dal* Industry- Production process of *Dal*.

Edible oil industry- Types of oil commonly used in India process of manufacturing edible oil Groundnut, and *Soyabean,* Starch, Glucose, and Dextrose Industry- Starch industry – getting starch from *maize* importance of starch Indian starch industry Glucose- Production of glucose, applications of glucose Indian glucose industry Dextrose – uses of dextrose production and Indian dextrose industry.

UNIT- V

Other part of plants-based Industries: Sugar and Jaggery Industries- Sugar industry, bio- ethanol sugar production of India, manufacturing process of sugar in India types of sugar. Jaggery industry- types of jaggery, processing of jaggery benefit of jaggery.

Jute and *Agarbatti* stick making Industry. - *Jute* industry, history of *jute* industry in India used of *jute Agarbatti-Agarbatti* making business in India, manufacturing process of *Agarbatti* production of *Agarbatti*, future of *Agarbatti* industry in India Project proposal preparation for Establishment of an Industry. Grants and Funding provider organizations of India – India grants PMMY (*Pradhan Mantri Mudra yojana*) RKVY (*Rastriya Krishi Vikash yojana*) SIDBI Fund and scheme.

Practical Content **Credits: 2**

- Preparation of *Holi* colours from locally available flowers.
- Perfume extraction process by distillation method.
- Preparation and preservation techniques of jams, jellies and prickles.
- Extraction and preservation of juices. (lemon and orange etc.)
- Preparation of different types of teas. (*Tulsi* tea, lemon tea etc.)
- Identification, collection and extraction of oil yielding leaves.
- Hands on training for preparation of *Douna* and *Pattal* using *Palash* and Banana leaves.

Reference Book

- Gerald E Wickens (Auth.)- Economic Botany Principles and Practice Kliver academic publishers 2001.
- Kocchar S.L.- Economic Botany Cambridge University Press U.K. 2016.
- Industrial Botany – Prof. Dr. Khan Mahfouz Raza and Prof. Dr. R.D. Joseph and Dr. Smita Krishnarao Kadwe.

Text Book

- Industrial and Commodity Uses of Tropical Plants by- R.H.M.J. Lemmens.
- Industrial Plant Biology by- Randhir. Singh. and Sudhir. P. Singh. and Bhavna Kaushik.
- Industrial Crop Production by- Sant. S. Virmani. and A. A. Sie.

Facilitating the achievement of course learning objectives

Unit No.	Course Learning Outcome	Teaching and Learning Activities	Assessment Tasks
1	Understand the environmental impact of timber harvesting and processing and explore sustainable forestry practices.	Instructor-led lectures to provide theoretical knowledge about the timber industry, tree identification, and forest management principles. Engage students in discussions to explore key concepts and stimulate critical thinking.	Class test focusing and short questions.
2	Students should develop a comprehensive understanding of industries that rely on leaves as a primary resource. This includes industries like tea, tobacco, herbal medicine, and natural products.	Traditional lectures can provide a foundational understanding of the subject matter. Instructors can use multimedia presentations, guest speakers from the industry, and case studies to make the lectures engaging.	Class test focusing on long and short questions.
3	Understand the processes involved in handling and preserving flowers, including techniques to extend shelf life and maintain product quality.	Organize hands-on floral design workshops where students can learn and practice various floral arranging techniques. This can include creating bouquets, centrepieces, wreaths, and other floral arrangements.	Class test focusing short and questions.
4	Develop a comprehensive understanding of industries that rely on fruits and seeds as key resources, including agriculture, food processing, beverage production, seed production, and nut processing.	organize visits to fruit orchards, seed farms, and agricultural fields to give students firsthand exposure to cultivation practices and production processes.	Class test focusing on and short questions.
5	Students will develop a comprehensive understanding of the various parts of plants, including roots, stems, leaves, flowers, and non-food parts like fibres, extracts, and resins, and their potential industrial applications.	Analyse real-world case studies of companies and industries that utilize plant-based resources. This helps students apply theoretical knowledge to practical scenarios and understand the challenges and opportunities in these sectors.	Class test focusing on and long questions.

MINOR CORE COURSE

3SRMM504: Chemistry-V (Research Methodology for Chemistry)

(Credits: Theory-2 Practical-2)

Scheme of Examination

Course Code	Course Name	Credits	Maximum Marks Allotted						Duration of exam	
			Theory			Practical				
			End Sem	Mid Sem	Assign	End Sem	Term Sem	Total	Theory	Practical
3SRMM504	Chemistry-V (Research Methodology for Chemistry)	4(2-0-2)	60	20	20	60	40	200	3 hr	2 hr

Course Objectives

The objective of this paper is to formulate the research problems and connect the research outcomes to the society. Student should be able to assess the local resources and opportunities in public domains. It further helps in gaining the knowledge of safety and ethical handlings of chemicals in lab and households.

Course Learning Outcomes

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

- Learn how to identify research problems.
- Evaluate local resources and need for addressing the research problem
- Find out local solution.
- Know how to communicate the research findings.

Syllabus Credits: 2-0-2

UNIT-I

Literature Survey

Print: Sources of information: Primary, secondary, tertiary sources; Journals: Journal abbreviations, abstracts, current titles, reviews, monographs, dictionaries, text-books, current contents, Introduction to Chemical Abstracts and Beilstein, Subject Index, Substance Index, Author Index, Formula Index, and other Indices with examples.

Digital: Web resources, E-journals, Journal access, TOC alerts, Hot articles, Citation index, Impact factor, H-index, E-consortium, UGC infonet, E-books, Internet discussion groups and communities, Blogs, Preprint servers, Search engines, Scirus, Google Scholar, Chem. Industry, Wiki- Databases, ChemSpider, Science Direct, Scopus.

Information Technology and Library Resources: The Internet and World Wide Web. Internet resources for chemistry. Finding and citing published information. Open-source Lead lectures. Open-source chemistry designing sources, Essentials of Problem formulation and communication with society.

UNIT-II

Methods of Scientific Research and Writing Scientific Papers

Reporting practical and project work. Idea about public funding agencies of research, Writing literature surveys and reviews. Organizing a poster display. Giving an oral presentation. Writing scientific papers – justification for scientific

contributions, bibliography, description of methods, conclusions, the need for illustration, style, publications of scientific work. Writing ethics. Avoiding plagiarism. Assessment of locally available resources.

UNIT-III

Chemical Safety and Ethical Handling of Chemicals

Safe working procedure and protective environment, protective apparel, emergency procedure and first aid, laboratory ventilation. Safe storage and use of hazardous chemicals, procedure for working with substances that pose hazards, flammable or explosive hazards, procedures for working with gases at pressures above or below atmospheric level. Safe storage and disposal of waste chemicals. Recovery, recycling and reuse of laboratory chemicals. Procedure for laboratory disposal of explosives. Identification, verification and segregation of laboratory waste. Disposal of chemicals in the sanitary sewer system. Incineration and transportation of hazardous chemicals.

UNIT-IV

Data Analysis

The Investigative Approach: Making and Recording Measurements. SI Units and their use. Scientific method and design of experiments.

Analysis and Presentation of Data: Descriptive statistics. Choosing and using statistical tests. Chemometrics. Analysis of variance (ANOVA), Correlation and regression, Curve fitting, fitting of linear equations, simple linear cases, weighted linear case, analysis of residuals, General polynomial fitting, linearizing transformations, exponential function fit, r and its abuse. Basic aspects of multiple linear regression analysis.

Biostatistics: brief introduction and data handling

UNIT-V

Electronics

Basic fundamentals of electronic circuits and their components used in circuits of common instruments like spectrophotometers, typical circuits involving operational amplifiers for electrochemical instruments. Elementary aspects of digital electronics.

Practical Credits :2

- Ethical handlings of chemicals in the lab and households.
- Methods of Scientific Research and Writing Scientific Papers: Reporting practical and project work. Writing literature surveys and reviews. Organizing a poster display.
- Chemical Safety and Ethical Handling of Chemicals: Safe working procedure and protective environment, protective apparel, emergency procedure and first aid, laboratory ventilation.
- Data Analysis the Investigative Approach: Making and Recording Measurements. SI Units and their use. Scientific method and design of experiments.

Reference Books

- Dean, J. R., Jones, A. M., Holmes, D., Reed, R., Weyers, J. and Jones, A. (2011) Practical skills in chemistry. 2nd Ed. Prentice-Hall, Harlow.
- Hibbert, D. B. and Gooding, J. J. (2006) Data analysis for chemistry. Oxford University Press.
- Topping, J. (1984) Errors of observation and their treatment. Fourth Ed., Chapman Hall, London.
- Harris, D. C. Quantitative chemical analysis. 6th Ed., Freeman (2007) Chapters 3-5.
- Levie, R. de, how to use Excel in analytical chemistry and in general scientific data analysis. Cambridge Univ. Press (2001) 487 pages.
- Chemical safety matters – IUPAC – IPCS, Cambridge University Press, 1992.

Text Book

- Research Methodology in Chemical Sciences: Experimental and Theoretical Approaches by Tanmoy Chakraborty and Shounak Roy.

- Chemical Research: A Practical Guide for Undergraduates by Robert J. Ouellette and J. David Rawn.
- Research Methodology in Chemistry and Chemical Engineering by H. Panda.

Facilitating the achievement of course learning objectives

Unit No.	Course Learning Outcome	Teaching and Learning Activities	Assessment Tasks
1.	The distinctions between primary, secondary, and tertiary sources of information in the context of scientific research.	Theory class on Navigate and utilize digital resources including e-journals, databases, search engines, and academic websites.	Compile a comprehensive report summarizing the findings, including references from various sources such as databases, and textbooks.
2.	Importance of ethical considerations in scientific writing and avoid plagiarism.	Teaching will be done through lectures and discussion mode. Demonstrate the ability to justify the scientific contributions of their work and follow appropriate publication styles.	Write a scientific paper on a laboratory experiment or research project.
3.	Laboratory ventilation and storage requirements for hazardous substances. Apply procedures for working with gases at varying pressures and dispose of waste chemicals properly.	Implement safe working procedures and maintain a protective environment in a laboratory setting.	Class test focusing short and questions.
4.	Recognize the importance of data analysis in drawing meaningful conclusions from experiments.	Teaching will do through lectures and discussion mode. Make accurate measurements and record data effectively.	Analyse a set of experimental data using appropriate statistical methods.
5.	Identify and analyse typical circuits involving operational amplifiers used in electrochemical instruments.	Teaching will do through lectures and discussion mode. Apply electronic principles to enhance their understanding of scientific instrumentation	Document the circuit design, components used, and testing procedures.

RAMANUJAN SCHOOL OF SCIENCE

BACHLOR OF SCIENCE

(Microbiology)

(B. Sc. (Microbiology) – CKUG04C03)

VI Semester

MAJOR CORE COURSE - I

3SMGC603 Microbiology-VI (Molecular Biology and Genetic Engineering)

(Credits: Theory-4 Practical-2)

Scheme of Examination

Course Code	Course Name	Credits	Maximum Marks Allotted						Duration of exam	
			Theory			Practical				
			End Sem	Mid Sem	Assign	End Sem	Term Sem	Total	Theory	Practical
3SMGC603	(Molecular Biology and Genetic Engineering	6(4+0+2)	60	20	20	60	40	200	3hr	2hr

Course Objective

- Comprehensive understanding of the historical development and key concepts in molecular biology, including genetic engineering, and be able to discuss ethical issues associated with genetic manipulation.
- Demonstrate knowledge of extra chromosomal genetic materials such as plasmids, cosmids, transposons, and various genetic elements like silent genes, exons, and introns.
- Identify and differentiate between different types of mutations, including spontaneous and induced mutations, and understand their molecular mechanisms and implications.
- Understand the fundamental processes of DNA replication, transcription, and translation, including the enzymes involved and the regulation of gene expression in microbial systems.

Course Outcomes

- Advancements in Genetic Engineering, in the field of biotechnology, agriculture and medicine.
- Gain insight into genetic recombination processes, including the molecular basis, genetic analysis, and the role of plasmids and bacteriophages in gene transfer.
- Develop practical skills in molecular biology techniques, including the use of plasmid and phage vectors, restriction enzyme digestion, ligation of vector and passenger DNA, transformation, selection and screening of recombinant colonies, and DNA sequencing.
- Knowledge about national or international research laboratories, biomedical or biotechnology institutions, pharmaceutical companies, biotechnology and genetic engineering application and research centers, genetic diagnosis centers, or fertility centers.

Syllabus: Theory (Credits 4-0-2)

UNIT - I

History of molecular biology, model systems, concepts of molecular biology, early history of genetic engineering, genetic engineering concepts, ethical issue. Extra chromosomal genetic material: plasmids, Cosmids, transposons, silent genes, exons and introns.

UNIT – II

Mutations: spontaneous and induced, base pair change, frame shift, deletion, inversion, random duplication, insertion, useful phenotypes (auxotrophs, conditional lethal, resistance). Reversion vs. suppression, Ame's test.

UNIT – III

DNA as genetic material; basic mechanism of replication, enzymes involved in replication, Enzymes involved in transcription translation, regulation of gene expression- transcription, translation and control of gene expression in microbes.

UNIT – IV

Genetic recombination; requirements, molecular basic, genetic analysis of recombination in bacteria, Biology of plasmids. Bacteriophage, lytic vs lysogenic phages, single stranded DNA phages.

UNIT – V

Plasmid and phage vectors, restriction and ligation of vector and passenger DNA, transformation of host cells. selection vs screening of recombinant colonies, analysis recombinant clones, DNA sequencing.

Practical: **(Credits 2)**

- Exercise on paper and gel electrophoresis.
- Characterization of genetic markers of known bacterial strain.
- Isolation of DNA from bacteria.
- Isolation o Plasmid DNA.
- Electrophoresis of Protein /DNA
- Estimation of DNA from Plant cells
- Demonstration of Southern Blot Technique.
- Perform electrophoresis of restricted DNA.
- Demonstration DNA amplification by PCR.
- Study of semi conservative replication of DNA through micrographs/schematic representations.
- Hybridization and detection of gene of interest)
    1. Demonstration of Northern Blotting.
    2. Demonstration of Western Blotting.

Textbook

1. A Text Book of Microbiology by D. K. Maheshwari.
2. Microbiology book by – Michael J. Pelzer and L.C.S. chain.
3. Text book of microbiology by C.P. Baweja.
4. A text book of microbiology by Anantha Narayan and Paniker's.

Reference Book

1. "Molecular Biology of the Gene" by James D. Watson, Tania A. Baker, Stephen P. Bell, Alexander Gann, Michael Levine, and Richard Losick (Publisher: Pearson).
2. "Principles of Genetics" by D. Peter Snustad and Michael J. Simmons (Publisher: Wiley).
3. "Genetics: A Conceptual Approach" by Benjamin A. Pierce (Publisher: W. H. Freeman).
4. "Molecular Cloning: A Laboratory Manual" by Michael R. Green and Joseph Sambrook (Publisher: Cold Spring Harbor Laboratory Press).
5. "Genomes" by T.A. Brown (Publisher: Garland Science).

Facilitating the achievement of course learning objectives

Unit No.	Course learning outcomes	Teaching and learning activities	Assessment tasks
1.	Understand the key milestones and discoveries in the history of molecular biology, including the elucidation of DNA structure.	Explain fundamental concepts in molecular biology, including DNA replication, transcription, and translation.	Multiple choice questions, short notes.
2.	Understand how mutations can lead to useful phenotypes, such as auxotroph and conditional lethality.	Explain the principles and significance of the Ames test in assessing mutagenicity.	Multiple choice questions, short notes, application on product Development.
3.	Understand how gene expression is controlled at the transcription and translation levels.	Explain the processes of transcription and translation in gene expression.	Short & long tests, application-based test and Projects.
4.	Understand the characteristics and importance of single-stranded DNA phages.	Explain the biology and significance of plasmids in genetic engineering.	Short and long tests, application-based test.
5.	Understand the process of transforming host cells with recombinant DNA and the significance of selection and screening.	Explain the principles of restriction enzyme digestion and DNA ligation in recombinant DNA technology.	Short and long tests, application-based tests.

***Assessment tasks listed here are indicative and may vary**.

MAJOR CORE COURSES - II

3SAMC603: Microbiology (Analytical Microbiology)

(Credits: Theory-4 Practical-2)

Scheme of Examination

Course Code	Course Name	Credits	Maximum Marks Allotted						Duration of exam	
			Theory			Practical				
			End Sem	Mid Sem	Assign	End Sem	Term Sem	Total	Theory	Practical
3SAMC603	Microbiology (Analytical Microbiology)	6(4+0+2)	60	20	20	60	40	200	3hr	2hr

Course Objective

- Analytical Microbiology focuses on the processes, methodologies, developments, and approaches involved in analytical microbiology, including microbiological, antibiotic, and amino acid assays and dilution methods.
- The selection first offers information on the theory of antibiotic inhibition zones, microbiological assay using large plate methods, and dilution methods of antibiotic assays.
- Discussions focus on serial dilution assay, requirements for accurate assay, microbiological assay of riboflavin, laws of adsorption and partition, mechanisms of antibiotic action, and biological considerations affecting the use of statistical methods.

Course Outcome

- define/explain within multiple microbiology disciplines the core theories and practices;
- describe/explain the processes used by microorganisms for their replication, survival, and interaction with their environment, hosts, and host populations;
- explain the theoretical basis of the tools, technologies and methods common to microbiology; and
- demonstrate practical skills in the use of tools, technologies and methods common to microbiology, and apply the scientific method and hypothesis testing in the design and execution of experiments.
- In addition, in upper-level courses, students will be able to:
- evaluate and respond to a complex question or challenge, using perspectives and scholarship drawn from microbiology and from cognate and non-cognate fields;

Syllabus: Theory (Credits 4-0-2)

UNIT – I Bioassays

Bioassay of growth supporting substances- Amino acids and Vitamins. Bioassay of growth inhibiting substances- Antibiotics. Automation of bioassay.

UNIT – II Quality Control

Quality control tests- Sterility testing, Microbial Limit Test (MLT). Pyrogen testing (LAL test), Minimum Inhibitory Concentration (MIC). FDA and Good Manufacturing Practices. Quantitative and qualitative analysis of food, milk, water and sewage.

UNIT – III: Colorimetry and Spectrophotometry

Lambert – Beer's Law. Ultraviolet, Visible, Infra-red and Fluorescence spectroscopy. Atomic absorption, Raman spectrum, X-ray Crystallography and NMR.

UNIT – III: Separation Techniques- I

Chromatography- Principle. Types of chromatography- Paper, Thin layer, Column, Ion exchange and Gas chromatography. Sedimentation and filtration.

UNIT – V: Separation Techniques –II

Electrophoresis- Principle and working. Agarose gel, native PAGE and SDS-PAGE. Principle, working and applications of centrifuge.

Practical's (Credits 2)

1. Isolation of antibiotic producer from soil sample.
2. Isolation of amylase producer from soil sample.
3. Estimation of soil micro flora.
4. Qualitative and quantitative examination of Food.
5. Qualitative and quantitative examination of Milk.
6. Qualitative and quantitative examination of Water.
7. Qualitative and quantitative examination of Sewage.
8. Microbial Limit Test- Tablets and syrups.
9. Determination of Phenol coefficient.
10. Separation of amino acids by TLC.
11. Separation of sugars by Paper chromatography.

Textbook

1. A Text Book of Microbiology by D. K. Maheshwari.
2. Microbiology book by Michael J. Pelzer and L.C.S. chain.
3. Text book of microbiology by C.P. Baweja.
4. A text book of microbiology by Anantha Narayan and Paniker.

Reference Book

1. Gottschalk G. (1986). Bacterial Metabolism. 2nd edition. Springer Verlag.
2. General Microbiology. 5th edition, McMillan Press by Stanier RY, Ingrahm JI, Wheelis ML and Painter PR. (1987).
3. "Microbiology: Principles and Explorations" by Jacquelyn G. Black, Laura J. Black (Publisher: John Wiley and Sons).
4. "Prescott's Microbiology" by Joanne Willey, Linda Sherwood, Christopher J. Woolverton (Publisher: McGraw-Hill Education).

Facilitating the achievement of course learning objectives

Unit No.	Course learning outcomes	Teaching and learning activities	Assessment tasks
1.	Understand the key milestones and discoveries in the history of molecular biology, including the elucidation of DNA structure.	Explain fundamental concepts in molecular biology, including DNA replication, transcription, and translation.	Multiple choice questions, short notes.
2.	Understand how mutations can lead to useful phenotypes, such as auxo trophy and conditional lethality.	Explain the principles and significance of the Ames test in assessing mutagenicity.	Multiple choice questions, short notes, application on product Development.

Unit No.	Course learning outcomes	Teaching and learning activities	Assessment tasks
3.	Understand how gene expression is controlled at the transcription and translation levels.	Explain the processes of transcription and translation in gene expression.	Short & long tests, application-based test and Projects.
4.	Understand the characteristics and importance of single-stranded DNA phages.	Explain the biology and significance of plasmids in genetic engineering.	Short & long tests, application-based test.
5.	Understand the process of transforming host cells with recombinant DNA and the significance of selection and screening.	Explain the principles of restriction enzyme digestion and DNA ligation in recombinant DNA technology.	Short and long tests, application-based tests.

***Assessment tasks listed here are indicative and may vary.**

MAJOR CORE COURSES - III

3SICC603: Microbiology-VI (Immunology and Clinical Microbiology)

(Credits: Theory-2 Practical-2)

Scheme of Examination

Course Code	Course Name	Credits	Maximum Marks Allotted						Duration of exam	
			Theory			Practical				
			End Sem	Mid Sem	Assign	End Sem	Term Sem	Total	Theory	Practical
3SICC603	(Immunology and Clinical Microbiology)	4(2+0+2)	60	20	20	60	40	200	3hr	2hr

Course Objective

- The student will be able to identify common infectious agents and the diseases that they cause.
- The student will be able to evaluate methods used to identify infectious agents in the clinical microbiology lab.
- The student will be able to recall microbial physiology including metabolism, regulation and replication.
- The student will be able to explain general and specific mechanisms by which an infectious agent causes disease.
- The student will be able to recognize and diagnose common infectious diseases from the clinical presentation and associated microbiology.
- The student will be able to describe the epidemiology of infectious agents including how infectious diseases are transmitted.

Course Outcome

- Students will be able to communicate scientific information effectively, especially relating to microbiological organisms, and the roles of microbial organisms in ecosystem function and health-related issues
- Students will be able to collect, analyze and interpret scientific data, including developing a familiarity with microbiology laboratory techniques and safety procedures
- Students will develop proficiency in the quantitative skills necessary to analyze biological problems (e.g., arithmetic, algebra, dimensional analysis, and statistical analysis as applied to biology), with a knowledge of specialized techniques used in microbiology.
- Students will be able to apply the scientific method as a demonstration that they understand its application furthering our knowledge of the microbial world
- Students will be able to describe fundamental principles of biology e.g., central dogma, diversity of life, inheritance and how these principles relate to microorganisms

Syllabus: Theory (Credits 2-0- 2)

UNIT - I

Infection and Immunity Normal flora of human body. Infection and its type. Mechanism of pathogenesis. Immunity – Natural and acquired. Vaccines – Preparation and types, vaccination schedule for children in India.

UNIT – II

Epidemiology of infectious diseases Transmission of diseases. Types of diseases – Epidemic, Pandemic, Sporadic. Nosocomial Infections. Epidemiological Methods – Descriptive, Analytical and Experimental Epidemiology. Antibiotics – Mode of action and development of resistance.

UNIT – III

Components of Immune System Organs and cells involved in immune response. Antigen Properties and types, Adjuvants. Immunoglobulin – Separation, structure and types. Primary and secondary responses. Complement – Components and Biological activities.

UNIT – IV

Antigen – Antibody Reactions Antigen and antibody reactions – agglutination, precipitation. Toxin neutralization test. Immunofluorescence, ELISA, RIA. Allergic skin tests – Tuberculin test and Lepromin test.

UNIT – V

Microorganisms and Diseases Gram positive cocci – Staphylococcus aureus. Gram negative bacilli – Salmonella typhi. Acid fast bacteria – Mycobacterium tuberculosis. Anaerobic, Gram-positive bacilli – Clostridium tetani. Spirochaete – Treponema pallidum. Virus – Hepatitis and HIV.

Practical's (Credits 2)

1. Determination of Blood Groups.
2. Estimation of hemoglobin by Sahli's method.
3. Estimation of hemoglobin by Cyanmethemoglobin Method.
4. Total count of W.B.C.
5. Total count of R.B.C.
6. Differential W.B.C. count.
7. Flocculation reaction- VDRL.
8. Agglutination reaction- Widal test.
9. Examination of urine- chemical, physical, microscopic and bacteriological.
10. Isolation and identification of gram-positive bacteria: Staphylococcus aureus.
11. Isolation and identification of gram-negative bacteria: E. coli, Proteus sp. and Salmonella

Textbook

1. A Text Book of Microbiology by D. K. Maheshwari.
2. Microbiology book by Michael J. Pelczar and L.C.S. chain.
3. Text book of microbiology by C.P. Baweja.
4. A text book of microbiology by Anantha Narayan and Paniker's.

Reference Book

1. Jawetz, Melnick and Adelberg's Medical Microbiology by Karen C. Carroll, Janet S. Butel, Stephen A. Morse (Publisher: McGraw-Hill Education).
2. Review of Medical Microbiology and Immunology by Warren Levinson, Peter Chin-Hong, Elizabeth Joyce, Jesse Nussbaum, Brian Schwartz (Publisher: McGraw-Hill Education).
3. Microbiology: Principles and Explorations by Jacquelyn G. Black, Laura J. Black Jacquelyn G. Black, Laura J. Black.

Facilitating the achievement of course learning objectives

Unit no	Course Learning Outcomes	Teaching and learning activities	Assessment tools
1	Understand different components of the first-line defines, including physical and chemical barriers.	Describe the preparation and types of vaccines, including live attenuated and inactivated vaccines. Define infection and	Quiz, multiple choice questions, Flowchart preparation.

Unit no	Course Learning Outcomes	Teaching and learning activities	Assessment tools
		differentiate between various types of infections (bacterial, viral, fungal, etc.).	
2	Student will Understand Identify common pathogens associated with nosocomial infections.	Describe the various modes of disease transmission, including direct and indirect transmission.	Test Quiz, multiple choice questions.
3	Understand Differentiate between the various classes and subclasses of immunoglobulin's (IgG, IgM, IgA).	Discuss the structure of immunoglobulin's (antibodies) and their role in immune defences.	Test Quiz, multiple choice questions.
4	Understand the principles of antigen-antibody reactions, including agglutination and precipitation. Provide examples of diagnostic tests based on these reactions.	Describe the enzyme-linked immunosorbent assay (ELISA) and its uses in detecting antibodies and antigens. Discuss the radioimmunoassay (RIA) and its role in quantifying specific molecules in clinical samples.	Flowchart preparation, multiple choice questions, short answer.
5	Student will understand different type of bacteria and its causing disease.	Explain its role in causing typhoid fever and its transmission. Discuss preventive measures and treatment options for typhoid fever.	Flowchart preparation, multiple choice questions, short answer.

MINOR CORE COURSE

3SPRM604: Botany-VI (Plant Reproduction)

(Credits: Theory-2 Practical-2)

Scheme of Examination

Course Code	Course Name	Credits	Maximum Marks Allotted						Duration of exam	
			Theory			Practical				
			End Sem	Mid Sem	Assign	End Sem	Term Sem	Total	Theory	Practical
3SPRM604	Plant Reproduction	4(2+0+2)	60	20	20	60	40	200	3hr	2hr

Course Objectives

- Describe the anatomy and morphology of plant reproductive organs, including flowers, seeds, and fruits.
- Articulate the mechanisms and processes involved in plant reproduction, covering both sexual and asexual modes of reproduction.
- Differentiate between various plant life cycles, including alternation of generations, and comprehend the significance of each stage in the context of reproduction.
- Analyze the processes of pollination and fertilization, detailing the role of different agents (wind, insects, etc.) and their impact on plant diversity.

Course Learning Outcomes

- Identify and describe the various reproductive structures in plants, including flowers, fruits, and seeds.
- Explore different pollination methods, such as wind, insects, and animals, and analyze their significance in plant reproduction.
- Define and compare the life cycles of different plants, including alternation of generations, and understand the role of meiosis and mitosis.
- Investigate the processes of fertilization in plants, emphasizing the union of male and female gametes and the formation of zygotes.

Syllabus **Credits :2-0-2**

UNIT - I

Flower: Calyx, corolla, androecium, gynoecium, microsporangium: Anther wall, endothecium middle layers, tapetum, Sporogenous tissue; Male gametophyte: Formation of vegetative and generative cells, formation of sperms, megasporangium: Types of ovules, integuments, nucellus, megasporogenesis, female gametophyte: Types of female gametophytes, mature embryo sac, Haustorial behavior of embryo sac.

UNIT-II

Pollination: Pollination anther dehiscence, pollen transfer, self-pollination, cross pollination, Fertilization: Double fertilization, syngamy, endosperm: Types of endosperms, functions of endosperm.

UNIT-III

Embryogeny: Embryo zygote, Proembryo, Embryogeny and Embryogenesis in monocot and dicots: Polyembryony and parthenocarpy, Suspenser, Nutrition of embryo.

UNIT-IV

Embryology: Embryology in relation to taxonomy importance of embryological characters in taxonomic considerations, examples of the value of embryology in taxonomy.

UNIT-V

Dynamic of Fruit Growth: Dynamic of fruit growth biochemistry and biology of fruit maturation, apomixes, significance of apomixes. Vegetative reproduction. Experimental embryology, parthenocarpy.

Practical Content

Credits: 2

- To study the parts of flower.
- To cut the T.S. of anther, pollen and ovule.
- To cut the T.S. of Dicot and monocot embryo.
- To study of different types of ovules.
- To study of polyembryony and Parthenocarpy.

Reference Book

- Plant Reproduction by- Andrew. V. Roberts and Betty. Smocovitis.
- Plant Reproductive Ecology: Patterns and Strategies by- Jon. Lovett-Doust.
- Plant Reproductive Biology by- Kingsley. R. Stern. and Richard J. Geber.
- Plant Reproductive Systematics: Taxonomy and Evolution of Angiosperms by- Kurt. M. Neubig. and W. Mark. Whitten, and Norris H. William.

Text Book

- Plant Reproductive Development and Function by- D. L. Mulcahy and E. Ottaviano.
- Plant Reproduction: Molecular, Developmental, and Environmental Contexts by- S. C. H. Barrett. and R. J. D. Knight.
- Reproductive Biology of Plants by- K. R. Shivanna. and V. P. Singh.

Facilitating the achievement of course learning objectives

Unit no.	Course learning outcome	Teaching and learning activities	Assessment tasks
1	Understand the anatomy of a flower, including the parts such as petals, sepals, stamens, and pistils, and describe their functions in the reproductive process.	Take students on a field trip to a botanical garden or a local park to observe and identify various flowers in their natural habitat. Provide field guides and encourage students to make observations and take notes.	Class test focusing and short questions.
2	Understand the diversity of pollinators, including insects (e.g., bees, butterflies, beetles), birds (e.g., hummingbirds), bats, and wind, and their unique roles in pollination.	Take students on a field trip to a local garden or natural area where they can observe various pollinators in action. Provide binoculars and magnifying glasses for close-up observations.	Class test focusing on and short questions.
3	Understand the relevance of embryology in the medical field, including its role in understanding congenital defects and genetic disorders.	Provide students with preserved embryos or access to online resources with embryo images and videos. Have them observe and compare embryonic development at different stages.	Class test focusing short and questions.

4	Develop a comprehensive understanding of the process of embryonic development from fertilization through birth or hatching, including key stages and milestones.	Provide students with preserved embryos (e.g., chicken embryos) and dissecting kits, and guide them through the process of observing and identifying key embryonic structures at various developmental stages.	Class test focusing on and short questions.
5	Describe the different mechanisms of apomixis, such as apospory, diplospory, and parthenogenesis, and understand how they function at the cellular and genetic levels.	Start with a class discussion or lecture introducing the concept of apomixis, its historical background, and its significance in plant biology and agriculture.	Class test focusing on and long questions.

MINOR CORE COURSE

3SBIM604: Chemistry-VI (Biochemistry)

(Credits: Theory-2 Practical-2)

Scheme of Examination

Course Code	Course Name	Credits	Maximum Marks Allotted						Duration of exam	
			Theory			Practical				
			End Sem	Mid Sem	Assign	End Sem	Term Sem	Total	Theory	Practical
3SBIM604	Chemistry-VI (Biochemistry)	4(2-0-2)	60	20	20	60	40	200	3hr	2hr

Course Objective

- Understand biochemistry fundamentals, focusing on vitamins and their roles in health and disease prevention.
- Explore water's unique properties and its significance in biological systems.
- Study carbohydrates, lipids, amino acids, and nucleic acids, emphasizing their structures and functions.

Course Learning Outcomes

- Identify key vitamins, deficiency diseases, and their preventive measures.
- Explain water's role as a solvent, reactant, and pH regulator in biological processes.
- Recognize the structural diversity and biological functions of carbohydrates, lipids, amino acids, and nucleic acids.
- To study the biological phenomenon at cellular and molecular level is studied to gain knowledge about the principle that govern complex biological systems.

Course Learning Outcomes

- It is helpful to get knowledge of preparation of some complex compound.
- Separation and identification of binary organic mixture, prepare derivatives and know about physical instrumentation techniques

Syllabus Credits 2-0-2

UNIT- I

The foundations of biochemistry and Vitamins Cellular and chemical foundations of life. Structure and active forms of water soluble and fat-soluble vitamins, deficiency diseases and symptoms, hypervitaminosis.

UNIT- II

Water Unique properties, weak interactions in aqueous systems, ionization of water, buffers, water as a reactant and fitness of the aqueous environment.

UNIT-III

Carbohydrates and Glycobiology Monosaccharides - structure of aldoses and ketoses, ring structure of sugars, conformations of sugars, mutarotation, anomers, epimers and enantiomers, structure of biologically important sugar derivatives, oxidation of sugars. Formation of disaccharides, reducing and non-reducing disaccharides. Polysaccharides – homo and

heteropolysaccharides, structural and storage polysaccharides. Structure and role of proteoglycans, glycoproteins and glycolipids (gangliosides and lip polysaccharides). Carbohydrates as informational molecules, working with carbohydrates.

UNIT-IV

Lipids Building blocks of lipids - fatty acids, glycerol, ceramide. Storage lipids -triacylglycerol and waxes. Structural lipids in membranes –glycerophospholipids, galactolipids and sulpholipids, sphingolipids and sterols, structure, distribution and role of membrane lipids. Plant steroids. Lipids as signals, cofactors and pigments.

UNIT-V

Amino acids structure and classification, physical, chemical and optical properties of amino acids nucleic acids. Nucleotides - structure and properties. Nucleic acid structure – Watson-Crick model of DNA. Structure of major species of RNA – m RNA, t RNA and r RNA. Nucleic acid chemistry - UV absorption, effect of acid and alkali on DNA. Other functions of nucleotides - source of energy, component of coenzymes, second messengers.

Practical **Credits 2**

- Buffer solution preparation and pH measurement.
- Test of amino acids.
- Separation of amino acids by TLC.
- Estimation of DNA by diphenylamine method.
- Identification of lipids by TLC.
- Separation of sugar by paper Chromatography.

Reference Book

- Harper's Illustrated Biochemistry by Victor W. Rodwell, David A. Bender, and Kathleen M. Botham.
- Water: A Matrix of Life by Felix Franks.
- Principles of Carbohydrate Chemistry by R. W. Harding and T. J. L. Simeons
- Lipidomics: Comprehensive Mass Spectrometry of Lipids edited by Xianlin Han.
- Amino Acids, Peptides and Proteins in Organic Chemistry by Andrew B. Hughes.

Text book

- Lehninger Principles of Biochemistry by David L. Nelson and Michael M. Cox
- Biochemistry by Lubert Stryer, Jeremy M. Berg, and John L. Tymoczko.
- Water: A Comprehensive Guide for Brewers by John Palmer and Colin Kaminski.
- Carbohydrates: The Essential Molecules of Life by Robert V. Stick
- Lipid Biochemistry: An Introduction by Michael I. Gurr, John L. Harwood, and Keith N. Frayn.

Facilitating the achievement of course learning objectives

Unit no.	Course learning outcome	Teaching and learning activities	Assessment tasks
1	Grasp fundamental chemical concepts and principles, such as bonding, chemical reactions, and thermodynamics, as they apply to biochemistry.	Traditional lectures are often used to deliver essential content and introduce key biochemical concepts. Instructors may use multimedia presentations, slides, and diagrams to aid in understanding.	Class test focusing on short questions.

2	Describe the molecular structure of water, including its bent shape, covalent bonds, and polar nature. Explain how hydrogen bonding contributes to water's unique properties.	Use molecular model kits or interactive software to allow students to construct water molecules and explore the polarity of water and hydrogen bonding.	Laboratory report on the unique properties of water and its significance in biological systems.
3	Students should categorize monosaccharides based on the number of carbon atoms they contain (e.g., triose, pentose, hexose) and distinguish between aldoses and ketoses.	Provide students with samples of different monosaccharides and have them use chemical tests (e.g., Benedict's test, Fehling's test) to identify and differentiate between reducing and non-reducing sugars.	Presentation on the structure, properties, and biological significance of carbohydrates.
4	Define what lipids are and explain their role as essential biomolecules in living organisms.	Provide students with various fatty acids and ask them to identify and classify them based on chain length, degree of saturation, and the presence of functional groups.	Case study on the role of lipids in cellular structure and function.
5	Define what nucleic acids are and explain their role as essential biomolecules that store and transmit genetic information.	Provide students with molecular model kits to build physical models of DNA molecules. This hands-on activity helps students understand the double helix structure and complementary base pairing.	Essay on the structure, classification, and properties of amino acids and nucleic acids.