THASSIM BEEVI ABDUL KADER COLLEGE FOR WOMEN

A Minority Institution Sponsored by Seethakathi Trust, Chennai.

Recognized by DBT under Star College Scheme, Ministry of Science and Technology, Govt of India.

An Autonomous Institution Affiliated to Alagappa University, Karaikudi.

Accredited by NAAC with "A" Grade [CGPA:3.16] & ISO 9001:2015 Certified Institution.

Recognized by UGC under 2(f) & 12 (B),Kilakarai – 623517, Ramanathapuram District, Tamil Nadu

REGULATIONS AND SYLLABUS

(For the Candidates Admitted from the Academic Year 2026-2027 onwards)

DEPARTMENT OF MICROBIOLOGY



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ESTD. 1988

DEPARTMENT OF MICROBIOLOGY

M Sc & B Sc PROGRAMME

PROGRAMME

REGULATIONS AND SYLLABUS

[For the candidates admitted from the Academic Year 2026 – 2027 onwards]

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Kilakarai – 623517, Ramanathapuram District

Panel of Members-Broad Based Board of Studies

Chairperson: Dr H Noorul Samsoon Maharifa., Associate Professor and Head, Department of Microbiology & Biotechnology, R & D Head, TBAKC for Women, Kilakarai. **Teaching Experience:** 12 Years **Research Experience:** 12 years **Area of Research/ Specialization:** Microbiology, Bioinformatics, Nano Biotechnology	
University Nominee: Dr T Kavitha., Assistant Professor, Department of Microbiology, Science Campus, Alagappa University, Karaikudi. **Teaching Experience:** 16 years **Research Experience:** 8 years **Area of Research/ Specialization:** Agricultural and Environmental Microbiology, Biocontrol of plant microbial diseases, Biodegradation, Antimicrobial metabolites, Enzyme Biotechnology, Drug resistance	
Subject Expert 1: Dr M Reenaa., **Department:** Assistant Professor, Department of Biotechnology, Thiyagarajar College, Madurai. **Teaching Experience:** 8 Years **Research Experience:** 4 Years **Area of Research/ Specialization:** Medical microbiology, Bacteriology	
Subject Expert 2: Dr D MubarakAli., **Department:** Assistant Professor (Sr. Gr.), School of Life Sciences, BS Abdur Rahman Crescent Institute of Science and Technology, Chennai. **Teaching Experience:** 8 years **Research Experience:** 17 years **Area of Research/ Specialization:** Microbial Biotechnology, Nano Biomaterials, Biomass and Energy and Solution Plasma Process.	
Expert from Industry: Dr A Noorjahan Abdul Bari., CEO, Biofocus Scientific Solutions Pvt Ltd, Kumbakonam. **Research Experience:** 18 Years **Area of Research/ Specialization:** Marine Biotechnology product development and Innovative product development	

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Member: Dr O S Aysha., Vice Principal - Academic Affairs and Associate Professor, Department of Microbiology & Biotechnology, TBAKC for Women, Kilakarai. **Teaching Experience:** 31 years **Research Experience:** 28 years **Area of Research/ Specialization:** Medical & Environmental Microbiology	
Member: Dr K Arunthathi., Assistant Professor, Department of Microbiology, TBAKC for Women, Kilakarai. **Teaching Experience:** 8 Years **Research Experience:** 13 Years **Area of Research/ Specialization:** Environmental & Agricultural Microbiology	
Member: Ms M Thasneem., Assistant Professor, Department of Microbiology, TBAKC for Women, Kilakarai. **Teaching Experience:** 7 years 7 month **Research Experience:** 7 years 7 month **Area of Research/ Specialization:** Immunology, Marine Biotechnology	
Member: Dr G Hemapoojavalli., Assistant Professor, Department of Microbiology, TBAKC for Women, Kilakarai. **Teaching Experience:** 4 years 5 months **Research Experience:** 9 years 5 months **Area of Research/ Specialization:** Marine Microbiology, Medical, Pharmacology, and Bioprocessing	
Member: Ms K Ganishka., Assistant Professor, Department of Microbiology, TBAKC for Women, Kilakarai. **Teaching Experience:** 4 years 7 months **Research Experience:** 4 years 7 months **Area of Research/ Specialization:** Environmental Biotechnology, Marine Biotechnology	

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Member: Ms R Malini., Assistant Professor, Department of Microbiology, BAKC for Women, Kilakarai. **Teaching Experience:** 3 years **Research Experience:** 3 years **Area of Research/ Specialization:** Microalgal biofuel production, Environmental Microbiology	
Member: Ms S Tamil Ilakkiya., Assistant Professor, Department of Microbiology, TBAKC for Women, Kilakarai. **Teaching Experience:** 2 Years **Research Experience:** 2 Years **Area of Research/ Specialization:** Medical Microbiology & Environment Microbiology	
Member: Ms B Karthika., Assistant Professor, Department of Microbiology, TBAKC for Women, Kilakarai. **Teaching Experience:** 5 Months **Research Experience:** 1Year **Area of Research/ Specialization:** Medical Microbiology	
Alumni: Ms R Rajapriya., Alumna TBAKCW (Batch – 2014 - 2017), Research Scholar, Department of Microbiology, Alagappa University, Karaikudi, **Teaching Experience:** 1 year **Research Experience:** 5 years **Area of Research/ Specialization:** Biofilm, Bioactive compounds, Polymer Nanoparticles, Molecular Biology	

XXIII ACADEMIC COUN

THASSIM BEEVI ABDUL KADER COLLEGE FOR WOMEN (AUTONOMOUS)

DEPARTMENT OF MICROBIOLOGY

REGULATIONS AND SYLLABUS- (CBCS)

[For the candidates admitted from the Academic Year 2026 – 2027 onwards]

Name of the Department: Microbiology

Name of the Programme: M.Sc., Microbiology

Duration of the Programme: Full Time (Two Years)

Name of the Programme: B.Sc., Microbiology

Duration of the Programme: Full Time (Three Years)

Choice-Based Credit System

The Choice Based Credit System (CBCS) is an academic framework that provides flexibility in learning by enabling students to choose from a prescribed range of elective courses according to their interests, aptitude, and career aspirations, while completing the mandatory core courses of the programme. Under CBCS, each course is assigned a specified number of credits based on the academic workload, and students are required to earn the prescribed number of credits for the successful completion of the programme and the award of the degree. The system promotes learner-centric education, interdisciplinary exposure through elective choices, skill development, continuous assessment, and outcome-based learning in alignment with national higher education standards.

Programme: Master of Microbiology (M.Sc.,):

Programme means a course of study leading to the award of a degree in a specific discipline. M.Sc. Microbiology is a two-year postgraduate programme spread over four semesters, designed to provide advanced knowledge and practical skills in microbiology and its applications.

The programme covers General Microbiology, Microbial Physiology, Molecular Biology and Microbial Genetics, Food Microbiology, Environmental and Agricultural Microbiology, Recombinant DNA Technology, Medical Microbiology, Immunology and Immunodiagnostics, Research Methodology, and Entrepreneurship in Microbiology. It also provides extensive practical training in microbiological, molecular, immunological, and diagnostic techniques. Specialized Discipline-Specific Electives include Algal Technology, Enzymology, Genomics and Proteomics, Nanobiotechnology, Bioethics, Biosafety and IPR, and Bioinformatics, enabling interdisciplinary learning and advanced professional skills. The programme emphasizes research aptitude, critical thinking, laboratory proficiency, scientific communication, problem-solving, and ethical research practices. The dissertation provides students with an opportunity to undertake independent research under supervision. The programme aims to develop

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competent, research-oriented, socially responsible, and industry-ready graduates equipped for careers in research, healthcare, biotechnology, pharmaceutical, food, environmental, agricultural, academic, and allied life-science sectors, as well as for higher studies and entrepreneurship.

Programme: Bachelor of Microbiology (B.Sc.,):

The Bachelor of Science (B.Sc.,) in Microbiology is a three-year undergraduate programme designed to provide students with a strong foundation in the science of microorganisms and their applications in healthcare, agriculture, food, biotechnology, pharmaceuticals, industry, and environmental sustainability. The programme combines comprehensive theoretical knowledge with intensive laboratory training, experiential learning, internships, field visits, research projects, and skill-based education to develop scientific competence, technical expertise, critical thinking, and problem-solving abilities. Structured in accordance with the Choice Based Credit System (CBCS), Outcome-Based Education (OBE), and the National Education Policy (NEP) 2020, the curriculum includes Core Courses, Ability Enhancement Courses, Skill Enhancement Courses, Multidisciplinary Courses, and Value-Added Courses to provide interdisciplinary knowledge and practical exposure. Emphasis is placed on microbiological techniques, molecular biology, immunology, bioinformatics, biosafety, bioethics, scientific communication, and research methodology to prepare students for emerging challenges in life sciences. The programme also promotes ethical values, environmental responsibility, innovation, entrepreneurship, and lifelong learning, enabling graduates to pursue higher education, research, and rewarding careers in clinical and diagnostic laboratories, biotechnology and pharmaceutical industries, food and agricultural sectors, environmental organizations, quality assurance laboratories, and academic and research institutions.

Courses:

The Bachelor of Science (B.Sc.) and Master of Science (M. Sc) in Microbiology offers a comprehensive and multidisciplinary curriculum that combines fundamental knowledge with practical and research-oriented learning to prepare students for careers in microbiology and allied life sciences. The programme comprises Core Courses, Ability Enhancement Courses (AEC), Skill Enhancement Courses (SEC), Multidisciplinary Courses (MD), Common Value-Added Courses (CVAC), Language Courses, laboratory practicals, field visits, internships, project work, and online certification courses. The Core Courses provide a strong foundation in microbiology, while the AEC and SEC courses enhance scientific understanding, laboratory competence, technical expertise, and professional skills. Multidisciplinary and Value-Added Courses broaden students' knowledge in emerging areas such as biotechnology, bioinformatics, environmental science, public health, and sustainable development. Practical training, internships, field visits, and research projects enable students to apply theoretical concepts to real-world situations, develop critical thinking, problem-solving abilities, scientific communication, and ethical

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values. Overall, the curriculum is designed to foster academic excellence, innovation, lifelong learning, and employability, equipping graduates with the knowledge and competencies required for higher education, research, entrepreneurship, and careers in healthcare, pharmaceutical industries, biotechnology, food and agricultural sectors, environmental management, and quality assurance laboratories.

Credits:

The term "Credit" refers to the weight assigned to a course based on the academic workload required to achieve the prescribed learning outcomes. Credits are awarded on the basis of the number of instructional hours devoted to lectures, tutorials, seminars, practical sessions, projects, internships, field-based learning, and other academic activities during a semester. Normally, one credit is equivalent to one hour of lecture or tutorial per week throughout a semester. For practical training, fieldwork, internships, project work, or other experiential learning activities, one credit is equivalent to two hours of engagement per week. The credit system facilitates the measurement of student workload, academic progression, and successful completion of the programme requirements.

Semesters:

The academic year shall be divided into two semesters, namely the Odd Semester and the Even Semester. Each semester shall consist of 90 working days, with a minimum of 15 weeks of instruction. The remaining period shall be utilized for continuous assessment, end-semester examinations, evaluation, and related academic activities.

The academic schedule shall normally comprise 30 instructional hours per week spread over five working days. In addition, 6 hours per week shall be allotted for Skill Development Courses (SDCs) and other skill-enhancement activities to strengthen students' employability, entrepreneurship, communication, and professional competencies.

The curriculum shall be delivered through lectures, tutorials, seminars, presentations, assignments, projects, internships, field-based learning, and other learner-centric pedagogical practices as prescribed by the Department and the Institution.

Medium of Instruction:

English

Departmental committee:

The Departmental Committee shall consist of a minimum of five senior faculty members of the Department and shall function as the primary academic body for planning, implementation, and monitoring of the programmes offered by the Department. The Committee shall be responsible for curriculum development, course design, preparation and revision of syllabi, allocation of credits, and the effective conduct of teaching, learning, assessment, and evaluation processes. It shall recommend the

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introduction, modification, or revision of Core, Elective, Skill Enhancement, Value-Added, and other courses in accordance with the Programme Outcomes, Programme Specific Outcomes, and institutional requirements.

The Departmental Committee shall oversee student admissions, academic advising, mentoring, internship and project activities, and the conduct of Continuous Internal Assessment (CIA). Faculty members handling courses shall maintain attendance records and assessment documents pertaining to assignments, seminars, presentations, tests, and other evaluation components. The Head of the Department shall coordinate the academic activities of the Department, consolidate attendance and assessment records, and submit the required documents and reports to the Controller of Examinations and other statutory bodies of the College. The recommendations of the Departmental Committee relating to curriculum and academic matters shall be forwarded to the Board of Studies for consideration and approval.

Programme Educational Objectives (PEO):

PEO1	**Leadership, Professional Competence, and Ethical Values:** To create and strengthen women leaders through disciplinary knowledge, professional skills and ethical sensitivity
PEO2	**Entrepreneurship and Career Excellence:** To transform students as successful entrepreneurs to face the modern challenges
PEO3	**Innovation, Sustainability, and Social Responsibility:** To nurture the students to invent, innovate and create solutions for current moral, ecological and economic issues

Programme Specific Objectives (PSOs) for Postgraduate Programme:

PSO 1	**Advanced Disciplinary Knowledge:** Demonstrate advanced knowledge of microbiology, microbial physiology, genetics, and biotechnology
PSO2	**Critical Thinking and Scientific Problem Solving:** Analyse microbiological problems and develop appropriate scientific solutions.
PSO3	**Scientific Communication and Professional Skills:** Communicate microbiological concepts and research findings effectively.
PSO4	**Research, Digital Literacy, and Interdisciplinary Learning:** Apply modern microbiological, molecular, bioinformatics, and research techniques.
PSO5	**Career Readiness and Social Responsibility:** Apply microbiological knowledge in healthcare, food, agriculture, industry, and environmental sectors with professional ethics.

Programme Learning Outcome (PLOs) for Postgraduate Programme:

PLO1	**Advanced Disciplinary Knowledge:** Demonstrate advanced and in-depth knowledge of the concepts, theories, principles, and contemporary developments in the chosen discipline.
PLO2	**Critical and Analytical Thinking:** Apply advanced critical, analytical, and reflective thinking to evaluate information, interpret evidence, and address complex disciplinary and interdisciplinary issues.
PLO3	**Problem Solving:** Identify, analyze, and develop innovative, evidence-based solutions to complex academic, professional, industrial, and societal challenges.

KAHA ACADEMIC COUNCIL

PLO4	**Communication Skills**: Communicate effectively through oral, written, visual, and digital modes for academic, research, professional, and public engagement.
PLO5	**Research Competence**: Design, conduct, analyze, interpret, and disseminate research using appropriate methodologies while adhering to ethical research practices.
PLO6	**Digital and Technological Proficiency:** Utilize advanced digital technologies, analytical tools, artificial intelligence, and emerging technologies for research, innovation, and professional practice.
PLO7	**Innovation and Creativity**: Demonstrate creativity, innovation, and entrepreneurial thinking in developing sustainable solutions, products, services, and research outcomes.
PLO8	**Interdisciplinary and Multidisciplinary Perspective:** Integrate knowledge from multiple disciplines to address complex problems and contribute to holistic and sustainable development.
PLO9	**Leadership and Teamwork:** Exhibit leadership, teamwork, decision-making, project management, and collaborative skills in multidisciplinary and professional environments.
PLO10	**Ethics and Professional Integrity**: Practice ethical values, academic integrity, professional responsibility, accountability, and respect for intellectual property rights.
PLO11	**Social Responsibility**: Demonstrate commitment to community engagement, social justice, inclusiveness, equity, and national development through responsible professional practice.
PLO12	**Environmental Sustainability**: Apply sustainable practices and environmental stewardship to promote ecological balance, responsible resource management, and sustainable development.
PLO13	**Global and Cultural Competence**: Appreciate cultural diversity, demonstrate global perspectives, and function effectively in multicultural and international environments.
PLO14	**Employability and Entrepreneurship**: Develop advanced professional competencies, entrepreneurial abilities, leadership qualities, and adaptability for employment, self-employment, consultancy, and higher education.
PLO15	**Lifelong Learning:** Engage in lifelong learning, self-directed professional development, continuous skill enhancement, and reflective practice to respond to emerging knowledge, technologies, and global challenges.

Programme Specific Objectives (PSOs) for Undergraduate Programme:

PSO1	**Disciplinary Knowledge and Literary Understanding:** Demonstrate fundamental knowledge of microbiology, including microbial diversity, taxonomy, physiology, genetics, molecular biology, immunology, biotechnology, and their applications.
PSO2	**Critical Thinking and Creative Engagement:** Apply critical thinking, problem-solving, and analytical skills to understand microbial processes, interpret experimental results, and address microbiological problems creatively.
PSO3	**Communication and Language Proficiency:** Communicate microbiological concepts, scientific findings, and research outcomes effectively through oral, written, and digital communication.

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PSO4	**Research, Digital Literacy, and Interdisciplinary Learning:** Apply basic research methods, laboratory techniques, digital tools, and interdisciplinary knowledge to investigate microbiological problems and interpret scientific data.
PSO5	**Career Readiness and Social Responsibility:** Develop practical skills and professional competencies for careers in microbiology, healthcare, food, pharmaceutical, environmental, and biotechnology sectors while demonstrating ethical values and social responsibility.

Programme Learning Outcomes (PLOs) for Undergraduate Programme:

On completion of the degree programme, the students will be enabled with:

PLO1	**Disciplinary Knowledge:** Demonstrate comprehensive knowledge and understanding of the fundamental concepts, theories, principles, and practices of the chosen discipline.
PLO2	**Critical and Analytical Thinking:** Apply critical, analytical, and reflective thinking skills to evaluate information, interpret data, and address discipline-specific and real-world issues.
PLO3	**Problem Solving:** Identify, analyze, and develop appropriate solutions to academic, professional, and societal challenges using logical reasoning and evidence-based approaches.
PLO4	**Communication Skills:** Communicate effectively through oral, written, visual, and digital modes in academic, professional, and social contexts.
PLO5	**Research Aptitude:** Demonstrate the ability to investigate problems, collect and interpret information, apply appropriate methodologies, and draw meaningful conclusions.
PLO6	**Digital Literacy:** Utilize digital technologies, software applications, online resources, and emerging technological tools effectively for learning, research, innovation, and professional development.
PLO7	**Creativity and Innovation:** Exhibit creativity, originality, and innovative thinking in generating ideas, designing solutions, and contributing to disciplinary and interdisciplinary contexts.
PLO8	**Interdisciplinary Perspective:** Integrate knowledge and skills from multiple disciplines to understand complex issues and develop holistic solutions.
PLO9	**Leadership and Teamwork:** Demonstrate leadership qualities, collaborative abilities, interpersonal skills, and the capacity to work effectively both independently and as a member of diverse teams.
PLO10	**Ethics and Professional Responsibility:** Exhibit ethical behaviour, honesty,

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	accountability, integrity, and professional responsibility in academic, personal, and workplace settings.
PLO11	**Social Responsibility:** Recognize social obligations and actively contribute to community welfare, social justice, inclusiveness, and national development.
PLO12	**Environmental Sustainability:** Demonstrate awareness of environmental issues and adopt sustainable practices that contribute to ecological balance and responsible resource utilization.
PLO13	**Cultural Awareness and Global Competence:** Appreciate cultural diversity, respect different perspectives, and develop the ability to function effectively in multicultural and global environments.
PLO14	**Employability and Entrepreneurship:** Develop professional competencies, entrepreneurial mindset, career readiness, and adaptability required for employment, self-employment, and higher education.
PLO15	**Lifelong Learning:** Engage in continuous learning, self-directed development, and reflective practice to adapt to evolving knowledge, technologies, and societal needs.

Eligibility for admission

M.Sc. Microbiology

A candidate who has passed a Bachelor's Degree in Microbiology/Biotechnology/Biochemistry/Zoology/Botany/Life Sciences or a related discipline from any recognized University shall be eligible for admission to the M.Sc. Microbiology programme.

B.Sc. Microbiology

A candidate who has passed the Higher Secondary Examination (10+2) or an equivalent examination from a recognized Board shall be eligible for admission to the B.Sc. Microbiology programme.

Minimum Duration of Programme

The duration of the Undergraduate Programme shall be three years spread over six semesters and the duration of the Postgraduate Programme shall be two years spread over four semesters. Each academic year shall consist of two semesters, namely Odd and Even Semesters. The Odd Semester shall normally commnce in June/July and conclude in October / November, while the Even Semester shall normally commence in November/December and conclude in April/May. Each semester shall consist of a minimum of 90 working days with six instructional hours per day and five working days per week, excluding examination days, as prescribed by the College from time to time. This format is suitable for inclusion in the Regulations of all programmes offered by the College.

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Teaching–Learning Methods

The teaching–learning process shall adopt a blend of traditional and contemporary pedagogical approaches to facilitate effective knowledge acquisition, skill development, and holistic learning among students. Classroom instruction shall be delivered through lectures, interactive discussions, tutorials, seminars, group activities, case studies, assignments, and learner-centred teaching methods.

Faculty members shall make extensive use of Information and Communication Technology (ICT) tools such as PowerPoint presentations, smart boards, learning management systems, online resources, multimedia content, and computer-assisted instructional methods to enhance the learning experience.

Experiential and participatory learning shall be promoted through field visits, industrial visits, internships, educational tours, laboratory sessions, project work, surveys, workshops, guest lectures, hands-on training, and extension activities wherever applicable to the programme.

Student seminars, presentations, group discussions, role plays, peer learning activities, and academic interactions shall be organized periodically to improve communication skills, critical thinking, analytical abilities, creativity, and leadership qualities.

For science and technology programmes, laboratory sessions shall be conducted with due emphasis on safety practices, ethical conduct, and scientific temper. Students shall be trained to handle laboratory equipment, instruments, software tools, and other facilities independently under appropriate supervision.

Continuous assessment shall be carried out through class tests, quizzes, assignments, seminars, projects, practical records, model examinations, and other evaluation methods prescribed by the Department and the College. The academic progress of students shall be monitored regularly, and suitable remedial measures shall be provided for slow learners. All the learners shall be encouraged to participate in research activities, competitions, value-added courses, and skill enhancement programmes.

Interdisciplinary learning shall be promoted through Multidisciplinary courses and Value-Added Courses offered by various Departments of the College. Students shall be encouraged to enrol in such courses to broaden their knowledge base and enhance employability skills.

The teaching–learning process shall be continuously enriched through innovative pedagogical practices aligned with the objectives of TANSCHE, Outcome-Based Education (OBE), the National Education Policy (NEP) 2020, and the academic regulations of the College.

Components of the Programme

A Programme shall comprise a combination of courses designed to provide disciplinary knowledge, skill development, research orientation, employability competencies, and holistic education. The term "Course" refers to a component of learning within a programme and is equivalent to a "Paper"

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in the conventional system. The curriculum of a programme shall consist of the following categories of courses:

A. Major/Core Courses (CC)

Core Courses are compulsory courses that form the foundation of the programme. These courses provide comprehensive knowledge in the discipline and facilitate the development of subject-specific competencies, critical thinking, analytical reasoning, problem-solving abilities, research aptitude, and professional skills. Core Courses may include theory, practical, project work, dissertation, or any other component prescribed by the Department.

B. Discipline Specific Elective Courses (DSE)

Discipline Specific Elective (DSE) Courses are offered within the discipline to provide students with opportunities for specialization and advanced learning in areas of interest. Students shall choose the prescribed number of elective courses from the options provided by the Department under the either-or choice system, as approved in the curriculum. The selection of elective courses enables students to pursue their academic interests and career aspirations within the discipline. In addition, these courses shall enhance domain knowledge, interdisciplinary understanding, innovation, and employability skills.

C. Multidisciplinary Courses (MD)

Multidisciplinary Courses are designed to provide students with exposure to disciplines beyond their major field of study and to promote interdisciplinary learning, intellectual flexibility, and holistic education in accordance with the principles of the National Education Policy (NEP) 2020.

- Students shall complete the prescribed number of Multidisciplinary Courses as specified in the curriculum framework of the programme.
- Multidisciplinary Courses shall be offered by Departments other than the parent Department.
- Students shall have the opportunity to choose courses based on their interests, aptitude, and career aspirations, subject to the availability of seats and eligibility requirements, if any.
- The list of Multidisciplinary Courses offered in a semester shall be announced before the commencement of the semester.
- Students shall register for the course within the stipulated period prescribed by the College.
- The credits earned through Multidisciplinary Courses shall form part of the programme requirements and shall be included in the computation of credits for the award of the degree.
- The evaluation and grading of Multidisciplinary Courses shall be carried out in accordance with the regulations governing other credit courses of the programme.

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D. Ability Enhancement Courses (AEC)

Ability Enhancement Courses are designed to strengthen language proficiency, communication skills, professional ethics, environmental awareness, constitutional values, and other competencies required for personal and professional development.

E. Skill Enhancement Courses (SEC)

Skill Enhancement Courses focus on developing practical, technical, digital, entrepreneurial, and employability skills through hands-on and application-oriented learning experiences.

F. Value Added Courses (VAC)

Value Added Courses are intended to enrich the curriculum by providing additional competencies beyond the prescribed syllabus. These courses may focus on emerging trends, life skills, professional development, entrepreneurship, industry requirements, and societal needs.

G. Project Work / Dissertation

Students may undertake a Project Work, Dissertation, or Research Project as prescribed in the curriculum. This component aims to develop independent learning, research skills, analytical abilities, report writing, and presentation skills under the guidance of a faculty supervisor.

H. Internship / Field Training

Wherever applicable, students shall undergo Internship, Industrial Training, Field Work, Clinical Training, Community Engagement, or Institutional Visits as prescribed in the curriculum. Such activities shall provide experiential learning and practical exposure relevant to the programme.

I. Self-Learning Courses through MOOCs / Online Learning Platforms

To promote lifelong learning and self-directed learning, students shall be encouraged to enrol in online courses offered through recognized platforms such as SWAYAM, NPTEL, Coursera, edX, or other approved platforms.

- Registration for MOOCs shall be voluntary unless otherwise specified in the curriculum.
- Students may earn additional credits through successful completion of approved online courses.
- Credits earned through MOOCs may be transferred in accordance with the regulations of the College.
- Preference shall be given to courses that enhance domain knowledge, research skills, digital competencies, entrepreneurship, and employability.

The curriculum structure, credit requirements, and distribution of courses under each category shall be prescribed by the respective Board of Studies and approved by the Academic Council from time to time. The programme shall be aligned with the principles of Outcome-Based Education (OBE), Choice Based Credit System (CBCS), and the National Education Policy (NEP) 2020.

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J. Internship and Research project

1. Undergraduate (3-Year UG Programme)

- **Mandatory Timing:** The internship is compulsory and must be undertaken after the 4th semester.
- **Duration:** Between 60 to 120 hours.
- **Credits:** 2 to 4 credits.
- **Credit Mapping:** 1 credit is equivalent to 2 hours of engagement per week, or a total of 30 hours per semester.
- **Suggested Activities:** Hands-on training, short research projects, social/community projects, seminar attendance, or studying local enterprises/farmers/entrepreneurs.

2. Postgraduate (2-Year PG Programme / Research Extension)

Based on the baseline structure provided for advanced coursework and dissertations under the framework:

- **Mandatory Timing:** Typically undertaken during the final semester.
- **Duration:** A minimum of 360 hours of active engagement during the semester.
- **Credits:** 12 credits strictly designated for the Dissertation / Thesis / Research Project. (An additional 8 credits may be allocated for prerequisite Research Methodology and Core Tools/Techniques courses).

3. Evaluation & Academic Integrity

- **Evaluation Metrics:** Assessment is based on an internal activity logbook, the technical quality of the final report, skill acquisition, originality, and overall attendance.
- **Research Viva-Voce:** Evaluation of the final dissertation or research project includes a formal presentation and a viva-voce conducted by a panel consisting of one internal and one external examiner.
- **Plagiarism & Originality Rule:** Every final project report must include a signed undertaking from the student and an official originality certificate from the supervisor stating zero plagiarism and confirming the work has not been submitted elsewhere for another degree.

K. Project/Dissertation

The candidate shall undergo Project/Dissertation work during the final semester. The candidate should prepare a scheme of work for the dissertation/project and should get approval from the guide. The candidate, after completing the dissertation /project work, shall be allowed to submit it to the departments at the end of the final semester.

If the candidate is desirous of availing the facility from other departments/ universities/ laboratories/ organizations they will be permitted only after getting approval from the guide and HoD. In such a case, the candidate shall acknowledge the same in their dissertation/project work.

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Format to be followed for dissertation/project report

The format/certificate for thesis to be followed by the student is given below

- Title page
- Certificate
- Acknowledgment

Content as follows:

Chapter No	Title	Page number
1	Introduction	
2	Aim and objectives	
3	Review of literature	
4	Materials and Methods	
5	Result	
6	Discussion	
7	Summary	
8	References	

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Format of the title page

Title of Dissertation/Project work

Dissertation / Project work submitted in partial fulfilment of the requirement for the degree of Bachelor / Master of Arts / Science in _____

Submitted by

(Student Name)

(Register Number)

Under the guidance of

(Guide name)

(Designation)

Department of _____

Month and Year

THASSIM BEEVI ABDUL KADER COLLEGE FOR WOMEN

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Kilakarai – 623517, Ramanathapuram District

(Year)

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Format of certificates:

Certificate – Guide

This is to certify that the thesis entitled"_____" submitted to Thassim Beevi Abdul Kader College for Women, Kilakarai - 623517 in partial fulfilment for the degree of Bachelor / Master of Arts / Science in _____ by Ms_____, (Reg No: ----------) under my supervision. This is based on the results of studies carried out by her in the Department of _____, Thassim Beevi Abdul Kader College for Women, Kilakarai - 623517. This dissertation/Project or any part of this work has not been submitted elsewhere for any other degree, diploma, fellowship, or any other similar titles or record of any College or University or Institution.

Place: Kilakarai
Date:

Research Supervisor

Approved by

Head of the Department

Internal Examiner

External Examiner

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Certificate - (HoD)

This is to certify that the thesis entitled_____ ”
submitted by Ms _____(Reg No: _____) to the Thassim Beevi Abdul Kader College for Women, Kilakarai - 623517, in partial fulfilment for the award of the degree of Bachelor / Master of Arts / Science in _____ is a bonafide record of research work done under the supervision of Dr_____,

Professor/Associate/Assistant Professor, Department of _____, Thassim Beevi Abdul Kader College for Women. This is to further certify that the thesis or any part thereof has not formed the basis of the award to the student of any degree, diploma, fellowship, or any other similar title of any College or University or Institution.

Place: Kilakarai
Date: Head of the Department

Declaration (student)

I certify that

a. The Project entitled in the thesis is original and was done by myself under the supervision of my supervisor

b. The work has not been submitted to any other Institute for any degree or diploma.

c. I have conformed to the norms and guidelines given in the Ethical Code of Conduct of the Institute.

d. Whenever I have used materials (data, theoretical analysis, and text) from other sources, I have given due credit to them by citing them in the text of the thesis and giving their details in the references.

e. Whenever I have quoted written materials from other sources and due credit is given to the sources by citing them.

f. From the plagiarism test, it is found that the similarity index of the whole thesis is within 25% and single paper is less than 10% as per the university guidelines.

Place: Kilakarai
Date:

Student Name:
Reg No:

XXIII ACADEMIC COUNCIL

Internship

The students shall undergo Internship / industrial training in the reputed organizations for a minimum of two weeks to acquire industrial knowledge during the summer vacation of the IV semester and II Semester of UG and PG programmes, respectively. The students have to find an industry related to their discipline (Public limited/Private Limited/owner/NGOs, etc.) in consultation with the faculty in charge/Mentor and get approval from the Head of the Department before going for an internship / industrial training.

Format to be followed for the internship report

The format for the internship report to be followed by the student are given below

Format of the title page

Title of internship report

Internship report submitted in partial fulfillment of the requirement for the Bachelor / Master of Arts / Science in _____ to the Thassim Beevi Abdul Kader College for Women, Kilakarai - 623517.

By (Student Name)

(Register Number)

Department of _____

Month and Year

THASSIM BEEVI ABDUL KADER COLLEGE FOR WOMEN

A Minority Institution Sponsored by Seethakathi Trust, Chennai.

Recognized by DBT under Star College Scheme, Ministry of Science and Technology, Govt of India.

An Autonomous Institution Affiliated to Alagappa University, Karaikudi.

Accredited by NAAC with “A” Grade [CGPA:3.16] & ISO 9001:2015 Certified Institution.

Recognized by UGC under 2(f) & 12 (B).

Kilakarai – 623517, Ramanathapuram District

(Year)

XXIII ACADEMIC COUNCIL

Certificate (Faculty in-charge)

This is to certify that the internship report entitled"_____
" submitted to Thassim Beevi Abdul Kader College for Women, Kilakarai - 623517. in partial fulfilment for the Bachelor/Master of Arts / Science in _____ by Mr/Miss----------(Reg.No.:_____) under my supervision. This is based on the work carried out by her in the organization _____. This Internship report or any part of this work has not been submitted elsewhere for any other degree, diploma, fellowship, or any other similar record of any University or Institution.

Place: Kilakarai
Date:

Research Supervisor

Approved by

Head of the Department

Internal Examiner

External Examiner

XXIII ACADEMIC COUNCIL

Certificate (HoD)

This is to certify that the Internship report entitled "_____" Submitted by Miss._____(Reg No:) to the Thassim Beevi Abdul Kader College for Women, Kilakarai – 623517. in partial fulfillment for the award of the Bachelor / Master of Arts / Science in _____ is a bonafide record of Internship report done under the supervision of _____Professor/Associate / Assistant Professor, Department of _____, Thassim Beevi Abdul Kader College for Women, Kilakarai – 623517 and the work carried out by her in the organization _____,This is to further certify that the thesis or any part thereof has not formed the basis of the award to the student of any degree, diploma, fellowship, or any other similar title of any College or University or Institution.

Place: Kilakarai Head of the Department

Date:

Declaration (student)

This is to certify that the Internship report entitled "_____ "Submitted by Miss. _____(Reg No:) to the Thassim Beevi Abdul Kader College for Women, Kilakarai – 623517 in partial fulfillment for the award of the Bachelor / Master of Arts / Science in _____ is a bonafide record of Internship report done under the supervision of _____ Professor/Assistant Professor, Department of _____, Thassim Beevi Abdul Kader College for Women and the work carried out by her in the organization _____. This is to further certify that the thesis or any part thereof has not formed the basis of the award to the student of any degree, diploma, fellowship, or any other similar title of any College or University or Institution.

Place: Kilakarai Head of the Department

Date:

XXIII ACADEMIC COUNCIL

(Company supervisor or Head of the Organization)

This is to certify that the Internship report entitled"_____"submitted to Thassim Beevi Abdul Kader College for Women, Kilakarai – 623517. in partial fulfillment for the Bachelor / Master of Arts / Science in _____ by Ms_____(Reg No) under my supervision. This is based on the work carried out by her in our organization _____for the period of _____.This Internship report or any part of this work has not been submitted elsewhere for any other degree, diploma, fellowship, or any other similar record of any College or University or Institution.

Place:Kilakarai Supervisor or In charge

Date:

Chapter No	Title	PageNo.
1	Introductions	
2	Aim and objectives	
3	Organisation profile/ details	
4	Methods/ Work	
5	Observation and knowledge gained	
6	Summary and outcome of the Internship study	
	References	

Field Visit

The students shall undergo Field Visits to various Biofertilizer units, aquaculture farms, fish landing centres, sea food processing industries, vermiculture unit, Mushroom farms, Research Institutes, etc. to acquire industrial and practical knowledge during the first semester.

Format to be followed for Field Visit report

The format for Field Visit report to be followed by the student are given below

XXIII ACADEMIC COUNCIL

Format of the title page

Field Visit report

Submitted in partial fulfilment of the requirement for the Bachelor/Master of Arts / Science in _____ to the Thassim Beevi Abdul Kader College for Women, Kilakarai – 623517.

By

(Student Name)

(Register Number)

XXIII ACADEMIC COUNCIL

Department of _____

Month and Year

THASSIM BEEVI ABDUL KADER COLLEGE FOR WOMEN

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Recognized by UGC under 2(f) & 12 (B).

Kilakarai – 623517, Ramanathapuram District

(Year)

Format of certificate

(HoD)

This is to certify that the Field Visit report submitted by Miss_____(Reg No:_____ to the Thassim Beevi Abdul Kader College for Women, Kilakarai, in partial fulfilment for the award of the Bachelor / Master of Arts / Science in is a bonafide record of Field Visit reports carried out by her during _____. This is to further certify that the report or any part thereof has not formed the basis of the award to the student of any degree, diploma, fellowship, or any other similar title of any College or University or Institution.

Place: Kilakarai Head of the Department

Date:

Declaration (student)

I hereby declare that the Field Visit Report submitted to the Thassim Beevi Abdul Kader College for Women, Kilakarai – 623517 for the award of the Bachelor / Master of Arts / Science in has been carried out by me. This is my original and independent work carried out by me during _____ and has not previously formed the basis of the award of any degree, diploma, associateship, fellowship, or any other similar title of any College or University or Institution.

Place: Kilakarai Name:

Date: Reg.No:

XXIII ACADEMIC COUNCIL

- Acknowledgment
- Content as follows:

S. No.	Date	Field Visit	PageNo.	Signature
1				
2				
3				
4				
5				

No. of copies of the dissertation/internship report

The candidate should prepare five copies of the dissertation report and submit the same for the evaluation of examiners. After evaluation, one copy will be retained in the department library, one for the CoE office, one for Central Library, one copy will be retained by the guide and the student shall hold one copy. The candidate should prepare one copy of the field visit/internship report and submit it for the evaluation of examiners

External Examination for project/dissertation

- A candidate shall be declared to have passed in the Project / Dissertation / Internship if he/she gets not less than 40% in each of the Project / Dissertation / Internship and Viva- Voce and not less than 50% in the aggregate of both the marks for the Project/Dissertation /Internship Report and Viva-Voce.
- A candidate who gets less than 50% in the Project Report must resubmit the Project Report. Such candidates need to take the Viva-Voce on the resubmitted Project.

External Examination

The examinations shall be conducted separately for theory and practical to assess (remembering, understanding, applying, analysing, evaluating, and creating) the knowledge required during the study. There shall be two systems of examinations, viz., internal and external examinations. The internal examinations shall be conducted as Continuous Internal Assessment tests I and II (CIA Test I & II).

A. Internal Assessment

The internal assessment shall comprise a maximum of 40 marks for each subject. The following procedure shall be followed for awarding internal marks.

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S.No	Particulars	Under Graduates		Post Graduates	
		Break up	Passing Minimum	Break up	Passing Minimum
1.	**CIA: ESE PART- I, II &III**	**40:60**		**40:60**	
2.	**CIA**: Passing Minimum		**14**		**16**
3.	**ESE** Passing Minimum		**21**		**24**
4.	**Total** Passing Minimum		**40**		**50**
5.	PART IV CIA	-	**-**	NA	NA
6.	PART IV ESE Passing Minimum		**20**	NA	NA
7.	Syllabus Validity Period for Break of studies	Up to Seven years from the date of Admission of the programme.			

CIA QUESTION PAPER PATTERN FOR WRITTEN TEST [UG & PG]

Part – A	Objective Type (3 Questions)	3 × 1 = 3
Part – B	Either or pattern (3 Questions)	3 × 4 = 12
Part – C	Open Choice (1 out of 2 questions)	1 × 10 = 10
	Total	**25**

CIA COMPONENTS FOR UG & PG (THEORY)

CIA SPLITUP FOR UG	Marks	CIA SPLIT FOR PG	Marks
Test Average	25	Test	25
Attendance	5	Attendance	5
Quiz I Year/Assignment II Year/ Seminar III Year	5	Seminar	5
Classroom participation	5	Classroom participation	5
Total	**40**	**Total**	**40**

Note: Conduct two internal tests for each subject

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Evaluation criteria for e-Quiz

e-Quiz	No. of Questions: 20 MCQs
Game-based software application	**5 Marks**
Google Forms	
ERP software	

Note: Conduct the e-quiz in any one mode of the above methods

Two e-quiz assessments for each semester

Evaluation criteria for Assignment

Assignment	5 Marks
Scrapbook preparation	
Model making	
Poster making	
Case study	

Note: Choose any one mode of the above methods & two assignments for each semester

Evaluation criteria for Seminar

Seminar	5 Marks
Video making	
Audio integration with PPT	
YouTube upload	

Note: Choose any one mode of the above methods & two seminars for each semester

Evaluation criteria for classroom participation - Theory

Classroom participation	**Evaluation Criteria**	5 Marks
UG I year	Mind Mapping	
II year	Storyboard Preparation	
III year	Fact sheet preparation	
PG I year	Review paper	
II year	Research paper publication	

Note: Choose any one mode of the above methods

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CIA COMPONENTS FOR UG & PG (PRACTICAL)

CIA SPLIT FOR UG & PG	Marks
Test Average	25
Observation Record & Lab Performance	5
Record	5
Attendance	5
Total	**40**

Note: Conduct two internal tests for each subject

CIA Improvement Test:

A student who is unable to secure the minimum passing percentage in CIA of any course in a semester can appear for **ONE** CIA improvement test by making a request to the course teacher and HOD concerned.

Required CIA Marks

A student who did not pass any theory or practical paper with the minimum required marks for CIA even though she gets the minimum in the summative examinations may be permitted to appear for the supplementary exam by foregoing the CIA marks provided with

- She has appeared for at least one internal out of two for each course of a programme

If a student fails in CIA, she is not eligible to write ESE

B. External Assessment

There shall be examinations at the end of each semester, for odd semesters in the month of October / November; for even semesters in April / May. A candidate who does not pass the examination in any course(s) may be permitted to appear in such failed course(s) in the subsequent examinations to be held in October / November or April / May. However, candidates who have arrears in Practical shall be permitted to take their arrear Practical examination only along with Regular Practical examination in the respective semesters.

Attendance

*Attendance %	Marks
96 – 100	5
91 – 95	4
86 – 90	3
81 – 85	2
76 – 80	1
Less than 76	0

For all students who attended classes from the first day of re-opening

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Condonation Rules:

Attendance %	Condonation Fee per Course
70 – 74	100
60 -69	150
Less than 60	Not Eligible

Subject to the decision of the Appeals Committee.

- ✓ Consideration in attendance will be given for the first year students in the first semester only.
- ✓ If a candidate is lacking attendance on genuine medical grounds, she can apply for **condonation** to the Appeals Committee immediately; the Appeals Committee's decision will be final.
- ✓ Candidate can seek condonation for the shortage of attendance **only once for PG programmes and twice for UG** programmes during the entire duration of the programme.

Scheme of External Examination (Question Paper Pattern)
Theory - Maximum 60 Marks

Section A	10 questions. All questions carry equal marks. (Objective-type questions)	10 x 1 = 10	10 questions – 2 questions from each unit
Section B	5 questions Either / or type like 1.a (or) b. All questions carry equal marks	5 x 4 = 20	5 questions – 1question from each unit
Section C	5 Out of questions Any Three. All questions carry equal marks	3 x10 = 30	5 questions – 1 question from each unit
	Total	**60**	

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ESE QUESTION PAPER PATTERN FOR PART-IV
[NON-MAJOR ELECTIVES, SKILL BASED ELECTIVES AND GENERAL INTEREST COURSES]

Part – A Multiple Choice Questions	20 × 1 = 20
Part-B Either or pattern [from all the five units]	2 × 5 = 10
Part – C : Open Choice – One question from each unit Two out of five questions to be answered	2 × 10 = 20
Total	**50 Marks**

ESE QUESTION PAPER PATTERN FOR EXTRA CREDIT PAPER

Part – A [2 from each unit] All the ten questions to be answered	10 × 2 = 20
Part-B Either – or Type [2 questions from each unit] All five questions to be answered	5 × 7 = 35
Part – Open Choice [1 from each unit] Three out of five questions to be answered	3 × 15 = 45
Total	**100 Marks**

PRACTICAL –MAXIMUM 60 MARKS

Section A	Major experiment	15
Section B	Minor experiment	10
Section C	Experimental setup	10
Section D	Spotters (5 spotters x5 marks)	5
Section E	Record note	10
Section E	Viva – voce	10

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DISSERTATION /PROJECT REPORT MAXIMUM 200 MARKS -PG

Dissertation /Project report	100
Viva – voce	100
UG	
Project report	40
Viva-voce	60

EVALUATION

S.No	Programme	Semester	Nature of Valuation	Provision for Transparency	Provision for Revaluation
1.	UG	1-4	Single	Yes	Yes
2.	UG	5 & 6	Single	No	Yes
3.	PG	All Semesters	Single	No	Yes

Results

The results of all the examinations will be published on the college website after passing through the Result Awarding Board. Candidates, who have secured the pass marks in the End-Semester Examination and in the CIA but failed to secure the aggregate minimum pass mark (E.S.E + C I.A) have to reappear in the ESE examinations. A candidate shall be declared to have passed in the Project / Dissertation / Internship if she gets not less than 40% in each of the Project / Dissertation / Internship and Viva-Voce and not less than 50% in the aggregate of both the marks for Project / Dissertation / Internship Report and Viva-Voce. A candidate who gets less than 50% in the Project Report must resubmit the Project Report. Such candidates need to take the Viva-Voce on the resubmitted Project.

Supplementary Exams

Supplementary examinations for all final-semester students who have failed shall be conducted within one month of the publication of the April End-Semester Examination results

Grading of the Courses for UG Programme

The following table gives the marks, Grade points, Letter Grades and classifications meant to indicate the overall academic performance of the candidate. Conversion of Marks to Grade Points and Letter Grade (Performance in Course / Paper

XXIII ACADEMIC COUNCIL

SEMESTER GRADING SCALE UG

RANGE OF MARKS	GRADE POINTS	LETTER GRADE
90 – 100	9.0 – 10.0	O
80 – 89	8.0 – 8.9	D+
75 – 79	7.5 – 7.9	D
70 – 74	7.0 – 7.4	A+
60 – 69	6.0 -6.9	A
50 – 59	5.0 – 5.9	B
40 – 49	4.0 – 4.9	C
00 – 39	0.0	U
ABSENT	0.0	AAA

a) Successful candidates passing the examinations and earning GPA between 9.0 and 10.0 and marks from 90 – 100 shall be declared to have Outstanding (O).

b) Successful candidates passing the examinations and earning GPA between 8.0 and 8.9 and marks from 80 - 89 shall be declared to have Excellent (D+).

c) Successful candidates passing the examinations and earning GPA between 7.5 – 7.9 and marks from 75 - 79 shall be declared to have Distinction (D).

d) Successful candidates passing the examinations and earning GPA between 7.0 – 7.4 and marks from 70 - 74 shall be declared to have Very Good (A+).

e) Successful candidates passing the examinations and earning GPA between 6.0 – 6.9 and marks from 60 - 69 shall be declared to have Good (A).

f) Successful candidates passing the examinations and earning GPA between 5.0 – 5.9 and marks from 50 - 59 shall be declared to have Average (B).

g) Successful candidates passing the examinations and earning GPA between 4.0 – 4.9 and marks from 40 - 49 shall be declared to have Satisfactory (C).

h) Candidates earning GPA between 0.0 and marks from 00 - 39 shall be declared to have Re-appear (U).

i) Absence from an examination shall not be taken as an attempt.

From the second semester onwards, the total performance within a semester and continuous performance starting from the first semester are indicated respectively by Grade Point Average (GPA) and Cumulative Grade Point Average (CGPA). These two are calculated by the following formulate

XXIII ACADEMIC COUNCIL

GRADE POINT AVERAGE (GPA) = Σi Ci Gi / Σi Ci

GPA = Sum of the multiplication of grade points by the credits of the courses
Sum of the credits of the courses in a Semester

Classification of the final result

The final result of the candidate shall be based only on the CGPA earned by the candidate.

a) Successful candidates passing the examinations and earning CGPA between 9.5 and 10.0 shall be given Letter Grade (O+) and those who earned CGPA between 9.0 and 9.4 shall be given Letter Grade (O) and declared to have First Class –Exemplary*.

b) Successful candidates passing the examinations and earning CGPA between 7.5 and 7.9 shall be given Letter Grade (D) those who earned CGPA between 8.0 and 8.4 shall be given Letter Grade (D+) and those who earned CGPA between 8.5 and 8.9 shall be given Letter Grade (D++) and declared to have First Class with Distinction*.

c) Successful candidates passing the examinations and earning CGPA between 6.0 and 6.4 shall be given Letter Grade (A) those who earned CGPA between 6.5 and 6.9 shall be given Letter Grade (A+) and those who earned CGPA between 7.0 and 7.4 shall be given Letter Grade (A++) and declared to have First Class.

d) Successful candidates passing the examinations and earning CGPA between 5.0 and 5.4shall be given Letter Grade (B), and those who earned CGPA between 5.5 and 5.9 shall be given Letter Grade (B+) and declared to have passed in Second Class.

e) Successful candidates passing the examinations and earning CGPA between 4.0 and 4.4shall be given Letter Grade (C) and those who earned CGPA between 4.5 and 4.9 shall be given Letter Grade (C+) and declared to have passed in Third Class.

f) Absence from an examination shall not be taken as an attempt.

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CLASSIFICATION OF THE FINAL RESULT - UG

CGPA	Letter Grade	Classification of Final Result
9.5 – 10.0 9.0 and above but below 9.5	O+ O	First Class – Exemplary*
8.5 and above but below 9.0 8.0 and above but below 8.5 7.5 and above but below 8.0	D++ D+ D	First Class with Distinction*
7.0 and above but below 7.5 6.5 and above but below 7.0 6.0 and above but below 6.5	A++ A+ A	First Class
5.5 and above but below 6.0 5.0 and above but below 5.5	B+ B	Second Class
4.5 and above but below 5.0 4.0 and above but below 4.5	C+ C	Third Class
0.0 and above but below 4.0	U	Re-appear

CUMULATIVE GRADE POINT AVERAGE (CGPA) = $\Sigma_n \Sigma_i C_{ni} G_{ni} / \Sigma_n \Sigma_i C_{ni}$

CGPA = Sum of the multiplication of Grade Points by the entire Programme

Sum of the credits of the courses for the entire Programme

Where 'Ci' is the Credit earned for Course i in any semester ; 'Gi' is the Grade Point obtained by the student for Course i and 'n' refers to the semester in which such courses were credited.

CGPA (Cumulative Grade Point Average) = Average Grade Point of all the Courses passed starting from the first semester to the current semester.

Note: * The candidates who have passed in the first appearance and within the prescribed Semesters of the UG Programme (Major, Allied and Elective Courses alone) are alone eligible for this classification.

Grading of the Courses for PG Programme

The following table gives the marks, Grade points, Letter Grades and classifications meant to indicate the overall academic performance of the candidate.

XXIII ACADEMIC COUNCIL

SEMESTER GRADING SCALE PG

MARKS	GRADE POINT	LETTER GRADE
90 – 100	9.0 – 10.0	O
80 – 89	8.0 – 8.9	D+
75 – 79	7.5 – 7.9	D
70 – 74	7.0 – 7.4	A+
60 – 69	6.0 -6.9	A
50 – 59	5.0 – 5.9	B
00 – 49	0.0	U
ABSENT	0.0	AAA

a) Successful candidates passing the examinations and earning GPA between 9.0 and 10.0 and marks from 90 – 100 shall be declared to have Outstanding (O).

b) Successful candidates passing the examinations and earning GPA between 8.0 and 8.9 and marks from 80 - 89 shall be declared to have Excellent (D+).

c) Successful candidates passing the examinations and earning GPA between 7.5 – 7.9 and marks from 75 - 79 shall be declared to have Distinction (D).

d) Successful candidates passing the examinations and earning GPA between 7.0 – 7.4 and marks from 70 - 74 shall be declared to have Very Good (A+).

e) Successful candidates passing the examinations and earning GPA between 6.0 – 6.9 and marks from 60 - 69 shall be declared to have Good (A).

f) Successful candidates passing the examinations and earning GPA between 5.0 – 5.9 and marks from 50 - 59 shall be declared to have Average (B).

g) Candidates earning GPA between 0.0 and marks from 00 - 49 shall be declared to have Re-appear (U).

h) Absence from an examination shall not be taken as an attempt. From the second semester onwards the total performance within a semester and continuous performance starting from the first semester are indicated respectively by Grade Point Average (GPA) and Cumulative Grade Point Average (CGPA).

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CLASSIFICATION OF THE FINAL RESULT - PG

CGPA	Letter Grade	GRADE Point	Classification of Final Result
9.5 – 10.0	O+	10.0	First Class – Exemplary*
9.0 and above but below 9.5	O	9.5	
8.5 and above but below 9.0	D++	8.5	First Class with Distinction*
8.0 and above but below 8.5	D+	8.0	
7.5 and above but below 8.0	D	7.5	
7.0 and above but below 7.5	A++	7.0	First Class
6.5 and above but below 7.0	A+	6.5	
6.0 and above but below 6.5	A	6.0	
5.5 and above but below 6.0	B+	5.5	Second Class
5.0 and above but below 5.5	B	5.0	
0.0 and above but below 5.0	U	0	Re-appear

CUMULATIVE GRADE POINT AVERAGE (CGPA) = $\Sigma_n \Sigma_i C_{ni} G_{ni} / \Sigma_n \Sigma_i C_{ni}$

CGPA = Sum of the multiplication of Grade Points by the entire Programme

Sum of the credits of the courses for the entire Programme

Where 'Ci' is the Credit earned for Course i in any semester; 'Gi' is the Grade Point obtained by the student for Course i and 'n' refers to the semester in which such courses were credited.

CGPA (Cumulative Grade Point Average) = Average Grade Point of all the Courses passed starting from the first semester to the current semester.

Note: * The candidates who have passed in the first appearance and within the prescribed Semesters of the PG Programme are alone eligible for this classification.

a) Successful candidates passing the examinations and earning CGPA between 9.0 and 10.0 and marks from 90 – 100 shall be declared to have Outstanding (O).

b) Successful candidates passing the examinations and earning CGPA between 8.0 and 8.9 and marks from 80 - 89 shall be declared to have Excellent (D+).

c) Successful candidates passing the examinations and earning CGPA between 7.5 – 7.9 and marks from 75 - 79 shall be declared to have Distinction (D).

d) Successful candidates passing the examinations and earning CGPA between 7.0 – 7.4 and marks from 70 - 74 shall be declared to have Very Good (A+).

XXIII ACADEMIC COUNCIL

e) Successful candidates passing the examinations and earning CGPA between 6.0 – 6.9 and marks from 60 - 69 shall be declared to have Good (A).

f) Successful candidates passing the examinations and earning CGPA between 5.0 – 5.9 and marks from 50 - 59 shall be declared to have Average (B).

g) Candidates earning CGPA between 0.0 and marks from 00 - 49 shall be declared to have Re-appear (U).

h) Absence from an examination shall not be taken as an attempt. From the second semester onwards the total performance within a semester and continuous performance starting from the first semester are indicated respectively by Grade Point Average (CGPA) and Cumulative Grade Point Average (CGPA). These two are calculated by the following formulate

Maximum duration of the completion of the programme

The maximum period for completion of UG shall not exceed seven years continuing from the first semester and for PG within six years.

XXIII ACADEMIC COUNCIL

M Sc MICROBIOLOGY

[Two Year Regular Programme]

(For Students Admitted from 2026-2027)

Programme Specific Outcomes:

On completion of the Post Graduate Programme, the student will be able to gain

PSO1	Attain the knowledge relevant to the core concepts in microbiology
PSO2	Develop the capabilities to comprehend and communicate scientific concepts
PSO3	Acquire to apply the knowledge, skills, and values to fulfill the basic needs of society
PSO4	Graduates will develop new ideas, perspectives and improve their research skill
PSO5	Absorbs ethical, moral values and responsibilities of learning science
PSO6	Ability to extract implicit and explicit from social media
PSO7	Develop the potential to update the constantly evolving technology

PROGRAMME CODE: PMB
PROGRAMME STRUCTURE
MSc MICROBIOLOGY- (2026-27)

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S. No	Course Code	Course	Title of the Course	T/ P	SD | ENT | EMP	REG| NAT |GLO	Credits	Hours/ Week	Marks		
			I Semester						I	E	Total
1	KMMBC11	Core I	General Microbiology	T	SD | ENT | EMP	REG | NAT | GLO	5	6	40	60	100
2	KMMBC12	Core II	Biomolecules and Microbial Physiology	T	SD | ENT | EMP	REG | NAT | GLO	5	6	40	60	100
3	KMMBC13	Core III	Molecular Biology and Microbial Genetics	T	SD | ENT | EMP	REG | NAT | GLO	6	6	40	60	100
4	KMMBC14P	Core IV	Lab course in General Microbiology, Biomolecules and Microbial Physiology, Molecular Biology and Microbial Genetics	P	SD | ENT | EMP	REG | NAT | GLO	4	6	40	60	100

5	KMMBE1A/ KMMBE1B	DSE I	a. Algal Technology / b. Enzymology	T	SD | ENT | EMP	REG | NAT | GLO	5	6	40	60	100
6	KMMBX1/ KMMBX1O	Extra Credit-I	Life Science for Competitive Examination/ Online Course*	T	SD | ENT | EMP	REG | NAT | GLO	2	-	-	100	100
							25+2	30	200	300 + 100	500+ 100
			II Semester								
1	KMMBC21	Core V	Food Microbiology *Integrated courses-Principles of Downstream process in Bioprocess	T	SD | ENT | EMP	REG | NAT | GLO	5	6	40	60	100
2	KMMBC22	Core VI	Environmental and Agricultural Microbiology	T	SD | ENT | EMP	REG | NAT | GLO	5	6	40	60	100
3	KMMBC23	Core VII	Recombinant DNA Technology	T	SD | ENT | EMP	REG | NAT | GLO	5	6	40	60	100
4	KMMBC24 P	Core VIII	Lab Course in Environmental and Agricultural Microbiology, Food	P	SD | ENT | EMP	REG | NAT | GLO	5	6	40	60	100
5	KMMBE2A / KMMBE2B	DSE II	a. Genomicsand Proteomics/ b. Nanobiotechnology *Integrated courses- Biomedical Nanotechnology	T	SD | ENT | EMP	REG | NAT | GLO	5	6	40	60	100
6	KMMBX2/ KMMBX2O	Extra Credit-II	Biofertilizers Production/Online Course*	T	SD | ENT | EMP	REG | NAT | GLO	2	-	-	100	100
							25+2	30	200	300+ 100	500+ 100
			III Semester								
1	KMMBC31	Core IX	Medical Microbiology	T	SD | ENT | EMP	REG | NAT | GLO	5	6	40	60	100
2	KMMBC32	Core X	Immunology & Immunodiagnostics	T	SD | ENT | EMP	REG | NAT | GLO	5	6	40	60	100
3	KMMBC33	Core XI	Basics of Research	T	SD | ENT |	REG | NAT |	5	6	40	60	100

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			Methodology		EMP	GLO					
4	KMMBC34P	Core XII	Lab Course in Medical Microbiology, Immunology & Immunodiagnostics	P	SD | ENT | EMP	REG | NAT | GLO	5	6	40	60	100
5	KMMBE3A / KMMBE3B	DSE,III	a. Bioethics, Biosafety and IPR/ b.Bioinformatics	T	SD | ENT | EMP	REG | NAT | GLO	5	6	40	60	100
6	KMESX3/ KMMBX3O	Extra Credit - III	Employability Skills/ Online Course*	T	SD | ENT | EMP	REG | NAT | GLO	2	-	100	-	100
							25+2	30	200 +100	300	500+ 100
			IV Semester								
1	KMMBC41	Core XIII	Entrepreneurship in Microbiology	T	SD | ENT | EMP	REG | NAT | GLO	5	6	40	60	100
2	KMMBC42 DW	Core XIV	Dissertation	P	SD | ENT | EMP	REG | NAT | GLO	10	24	150	150	300
3	KMMBX4/ KMMBX4O	Compulsory Extra Credit	Information Technology for Biologists/ Online Course*	T	SD | ENT | EMP	REG | NAT | GLO	2	-	-	100	100
							15+2	30	190	210 +100	400+ 100
			Total				90+8	120	790 +100	1110 +300	1900+ 400

DSE- Discipline Specific Elective

* For online certification credit alone will be assigned on submission of certificate obtained through appearing for online examination from the spoken tutorial, EDX, NPTEL or Coursera and other MHRD, MOOCs

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Semester – I					
Course: Core I	**Course Code:** KMMBC11	**Course Title:** General Microbiology	**T**	**Credits:5**	**Hours: 6**

Unit – I	
Objective 1	To understand the history, classification, taxonomy, and fundamental concepts of microorganisms.

Introduction to Microbiology: History and development of Microbiology; Classification of microorganism – Binomial nomenclature, Haeckel‟s three kingdom concept, Whittaker‟s five kingdom concept, three domain concept of Carl Woese; Principle and classification of bacteria on the basis of Bergey‟s manual of Determinative Bacteriology; Molecular approaches in microbial classification, concept of microbial species.

Unit – II	
Objective 2	To study the morphology, structure, cellular organization, and sporulation of prokaryotic microorganisms.

Bacteriology: Prokaryotic cell morphology – structure and function of Flagella, Fimbriae, Pili; Capsule – types, composition and function; Cell wall-cell walls of Gram negative, Gram positive, Halophiles, L–forms and Archaebacteria; Cell membrane – Fluid Mosaic Model, membrane functions; Intracytoplasmic inclusions – Nucleoid and Extra Chromosomal material; Gas vesicles, Chlorosomes, Carboxysomes, Magnetosomes and Phycobilisomes; Reserve food materials – Polyhydroxybutyrate granules, Sulphur granules; Sporulation – Exospores and Endospores.

Unit – III	
Objective 3	To understand the basic concepts, classification, replication, and laboratory techniques of virology.

Virology: Historical developments in Virology, general properties of viruses; Structure of viruses, Lytic and Lysogenic life cycle; Classification of viruses – ICTV classification, Baltimore classification, Prions, Viroids.
Techniques in virology-Virus Cultivation Methods – Embryonated eggs, Animal models, Cell Line; Viral assay, Virus Isolation and Purification, Laboratory identification of Viruses, Cytopathic effect.

Unit – IV	
Objective 4	To understand the classification, structure, reproduction, and economic importance of fungi and lichens.

Mycology: History and development of Mycology, structure and cell differentiation; Criteria for fungal classification – Habitat Morphology and Reproduction of Slime molds, Oomycetes, Zygomycotina, Ascomycotina, Basidiomycotina, Mastigomycotina and Deuteromycotina; Economic importance of fungi, Mycotoxins, Mycorrhizae.
Lichens: classification, physiology and importance.

Unit – V	
Objective 5	To understand the classification, reproduction, ecological significance, applications of algae, and the general characteristics of important protozoan parasites.

Phycology: Distribution of Algae, Classification of algae, Thallus organization in algae, Reproduction in algae; Brief account of Chlorophyta, Bacillariophyta, Phaeophyta, Rhodophyta, Cyanobacteria and Prochlorons; Algal ecology; Applications of algae in Agriculture, Biofertilizer, Industrial application of algae, Medicinal importance, Nutritional value, Environmental implications.
Protozoa: Animal parasite: *Entamoeba histolytica, Giardia, Plasmodium* – general characteristics and reproduction.

Unit – VI

Self-Study Components:

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Students shall be encouraged to prepare for competitive examinations such as SET and NET by studying and integrating the concepts covered in the above five units.

Course Outcomes:	**K Level**
CO1: Explain the history, classification, taxonomy, and fundamental concepts of microorganisms.	K2
CO2: Describe the morphology, cellular organization, structural components, and sporulation of prokaryotic microorganisms.	K2
CO3: Apply the principles of virology, including virus classification, replication, cultivation, isolation, and laboratory identification techniques.	K3
CO4: Analyze the classification, structure, reproduction, and economic importance of fungi and lichens.	K4
CO5: Evaluate the classification, reproduction, ecological significance, and applications of algae and the characteristics of important protozoan parasites.	K5
CO6: Integrate the concepts of microbiology for problem-solving, higher studies, research, and competitive examinations.	K5

Suggested Readings:

- Joanne W., Kathleen S. and Dorothy W., *Prescott's Microbiology,* McGraw Hill Education, India, ISE, Eleventh Edition, 2019.
- Pelczar Jr. M.J., Chan E.C.S. and Kreig N.R., *Microbiology*, Mc-Graw Hill, 2021.
- Boyd R.F., *General Microbiology*, Times Mirror Mosby, USA, 2016.
- Sharma O.P., *Textbook of Algae*, Tata McGraw Hill Publishing Co. Ltd, 2017.

Online Resources:

- https://nptel.ac.in/courses/102103015/
- https://open.umn.edu/opentextbooks/BookDetail.aspx?bookId=404
- www.ebooks.cambridge.org/ebook.jsf?bid=CBO9781139170635
- www.grsmu.by/files/file/university/cafedry/.../files/essential_microbiology.pdf
- https://microbiologyinfo.co/top-and-best-microbiology-books/

K1-Remember	K2-Understand	K3-Apply	K4-Analyze	K5-Evaluate	K6-Create

Course designed by: Dr H Noorul Samsoon Maharifa

Course outcome Vs Programme Learning Outcomes

CO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	PLO 11	PLO 12	PLO 13	PLO 14	PLO 15
CO1	3	2	1	2	1	1	1	1	1	1	1	1	1	1	2
CO2	3	2	2	2	1	1	1	1	1	1	1	1	1	1	2
CO3	3	3	3	2	3	3	2	2	1	1	1	1	1	2	3
CO4	3	3	3	2	3	2	2	2	1	1	1	2	1	2	3
CO5	3	3	3	3	3	2	3	3	1	1	2	3	1	3	3
CO6	3	3	3	3	3	3	3	3	2	2	2	2	2	3	3
W.AV	3.00	2.67	2.50	2.33	2.33	2.00	2.00	2.00	1.17	1.17	1.33	1.67	1.17	2.00	2.67

S-Strong (3), M-Medium (2), L-Low (1)

Course outcome Vs Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	2	2	2	1	1	2
CO2	3	2	2	2	1	1	2
CO3	3	2	3	3	2	1	3
CO4	3	2	3	3	2	1	2
CO5	3	2	3	3	2	1	3
CO6	3	3	3	3	2	2	3
W.AV	3.00	2.17	2.67	2.67	1.67	1.17	2.50

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S-Strong (3), M-Medium (2), L-Low (1)

Semester – I					
Course: Core II	**Course Code:** KMMBC12	**Course Title:** Biomolecules and Microbial Physiology	**T**	**Credits:5**	**Hours:6**
Unit – I					
Objective 1	To understand the structure, classification, properties, and biological significance of biomolecules.				
Biomolecules: Carbohydrates – Structure and Classification, Nucleic acids: Biosynthesis and regulation – DNA &RNA; Amino acids – Classification and chemical properties. **Proteins:** Classification, Protein Structure – Primary Structure, Secondary Structure, Tertiary and Quaternary Structure; Enzymes – Nomenclature and Classification, Physical and Chemical Properties of enzymes; Vitamins – types of vitamins and their importance. Lipids – Classification.					
Unit – II					
Objective 2	To understand the major metabolic pathways and their regulation in microorganisms.				
Metabolic Pathways: Carbohydrates Metabolism and its regulation – Glycolysis, TCA cycle, Oxidative phosphorylation, Pentose phosphate pathway and Gluconeogenesis; Biosynthesis of Fatty acids, Triglycerides, Phospholipids and Cholesterol; Oxidation of Fatty Acids					
Unit – III					
Objective 3	To acquire knowledge of microbial cell structure, membrane transport, and protein export mechanisms.				
Biochemical components of microbial cell: Structure and functions of organelles of microbial cell, cell wall synthesis, role of cell wall and cell membrane in the functions of microbial cells; Membrane transport in bacteria-simple, group translocation, ABC transporters Protein export in bacteria –Type 1,2,3,4, Protein export pathways & antimicrobial therapy Iron - Siderophores & antimicrobial therapy.					
Unit – IV					
Objective 4	To understand microbial nutrition, growth, and the influence of environmental factors on microbial physiology.				
Mode of Nutrition: Microbial growth – different Phases of growth, factors influencing microbial growth – Temperature, pH, Pressure, Salt Concentration, Nutrients; Synchronous growth and continuous cultivation, Classification of microorganisms based on nutrition requirements; Physiology and classification of organisms living in extreme environments – Thermophiles, Halophiles, Psychrophiles and Methanogens.					
Unit – V					
Objective 5	To understand the principles and mechanisms of microbial photosynthesis and the factors affecting photosynthetic efficiency.				
Microbial Photosynthesis: Photoautotrophs; Photoorganotrophs; Photosynthetic pigments, Oxygenic and Anoxygenic types; Physiology of bacterial photosynthesis – Light reactions, Cyclic and Non-Cyclic Photophosphorylation; Factors affecting photosynthesis – Intrinsic and Extrinsic – Effect of light, CO_2, pH and Temperature on photosynthesis.					
Unit – VI					
Self-Study Components:					
Students shall be encouraged to prepare for competitive examinations such as SET and NET by studying and integrating the concepts covered in the above five units.					
Course Outcomes:					**K Level**
CO1: Explain the structure, classification and biological significance of carbohydrates, proteins, lipids, nucleic acids, enzymes and vitamins.					K2
CO2 Describe the major metabolic pathways of carbohydrates and lipids and					

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	explain their regulation in microbial systems.	K3
CO3	Analyze the biochemical components of microbial cells, membrane transport mechanisms and protein export systems.	K3
CO4	Explain microbial nutrition, growth kinetics, environmental factors affecting growth and adaptations of extremophiles.	K4
CO5	Illustrate the mechanisms of microbial photosynthesis and evaluate the factors influencing photosynthetic efficiency.	K3
CO6	Integrate biomolecular and microbial physiological concepts to solve microbiological problems and prepare for higher studies and competitive examinations.	K4

Suggested Readings:

- Lansing M. Prescott, John P. Harley and Donald A. Klein‟s, *Microbiology,* 10th Edition, Mc- Graw Hill, 2015.
- Satyanarayana U. and Chakrapani U., *Biochemistry*, Elsevier, Arunabha Sen Books and allied
- (P) Ltd, Kolkata, 5th Edition, 2020.
- Nelson, David L., and Cox, Michael M. Lehninger, *Principles of Biochemistry***,** United States, W. H. Freeman, 2021.
- S.Meena Kumari, *Microbial Physiology*, MJP Publisher, 2019.

Online Resources:

- https://nptel.ac.in/courses/102/103/102103015/#
- www.microbiologyonline.org.uk
- www.cambridge.org ›Home › Academic › Life science › Microbiology and immunology
- www.grsmu.by/files/file/university/cafedry/.../files/essential_microbiology.pdf
- https://microbiologyinfo.com/top-and-best-microbiology-books/

K1-Remember	K2-Understand	K3-Apply	K4-Analyze	K5-Evaluate	K6-Create

Course designed by: Dr H Noorul Samsoon Maharifa

Course Outcome vs Programme Learning Outcomes

CO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	PLO 11	PLO 12	PLO 13	PLO 14	PLO 15
CO1	3	3	2	2	2	1	1	2	1	1	1	1	1	1	2
CO2	3	3	3	2	3	2	2	2	1	1	1	1	1	2	3
CO3	3	3	3	2	3	3	2	2	1	1	1	1	1	2	3
CO4	3	3	3	2	3	2	2	3	1	1	2	3	1	2	3
CO5	3	3	3	2	3	2	2	3	1	1	1	3	1	2	3
CO6	3	3	3	3	3	3	3	3	2	2	2	2	2	3	3
W.AV	3.00	3.00	2.83	2.17	2.83	2.17	2.00	2.50	1.17	1.17	1.33	1.83	1.17	2.00	2.83

S-Strong (3), M-Medium (2), L-Low (1)

Cours Outcome vs Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	3	2	2	1	1	2
CO2	3	2	3	3	2	1	3
CO3	3	2	3	3	2	1	3
CO4	3	2	3	3	2	1	3
CO5	3	2	3	3	2	1	3

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CO6	3	3	3	3	2	2	3
W.AV	3.00	2.33	2.83	2.83	1.83	1.17	2.83

S-Strong (3), M-Medium (2), L-Low (1)

Semester – I					
Course: Core III	**Course Code:** KMMBC13	**Course Title:** Molecular Biology and Microbial Genetics	**T**	**Credits: 5**	**Hours: 6**

Unit – I

Objective 1	To understand the structure, replication, damage, and repair mechanisms of DNA and RNA.

Genetic material: DNA and RNA as the genetic material, nucleic acid structure types of DNA and RNA; Peptide Nucleic Acid (PNA). DNA replication: Prokaryotic and Eukaryotic DNA replication models, extra chromosomal replicons, inhibitors of DNA replication; Nucleosome assembly and telomere. DNA damage and repair: Mutagens – Physical and Chemical; Mechanism of repair – photoreactivation, excision repair, recombination repair; SOS and Adaptive responses and their regulation.

Unit – II

Objective 2	To understand the mechanisms and regulation of transcription and translation in prokaryotes and eukaryotes.

Transcription: Mechanism of transcription in Prokaryotes & Eukaryotes and its regulation Transcription Inhibitors, RNA transport, Post Transcriptional Modification; Genetic code, Wobble hypothesis.

Translation: Prokaryotic & Eukaryotic Translation, Translational Proof Reading,Translational Inhibitors, Post Translational Modifications.

Unit – III

Objective3	To acquire knowledge of genetic mutations, recombination, and genetic mapping in microorganisms.

Genetics: Genetic Nomenclature, Types of Mutants, Isolation and Characterization of Mutants, Revertants and Reversion, Genetic Analysis of Mutants. Genetic recombination: Homologous, Non-Homologous, Site Specific Recombination, Genetic Mapping, Linkage and Multifactor Crosses, Deletion Mapping,Complementation and Intragenic Complementation.

Unit – IV

Objective4	To understand the molecular biology and genetic regulation of bacteriophage λ.

Genetics of Phage λ: Biology of bacteriophage λ; Lytic growth of phage λ – DNA Replication and Phage production, Recombination in the λ life cycle; Lysogeny – Immunity and Repression, Molecular events in Lysogeny; Decision between Lysis and Lysogeny.

Unit – V

Objective5	To understand the mechanisms of horizontal gene transfer and transposable elements in microbial genetics.

Horizontal gene transfer methods: Transformation, Conjugation – Hfr, Triparental mating, Transduction – General and Specialized.Transposable elements: Introduction to Transposable Elements – Discovery and Types; Retrotransposon – Mechanism, SINES and LINES, Transposons of E.coli and Yeast.

Unit – VI

Self-Study Components:

Students shall be encouraged to prepare for competitive examinations such as SET and NET by studying and integrating the concepts covered in the above five units.

Course Outcomes:	**K Level**
CO1 Explain the structure, organization, replication, damage and repair mechanisms of DNA and RNA in prokaryotes and eukaryotes.	K2

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CO2: Describe the molecular mechanisms and regulation of transcription and translation, including post-transcriptional and post-translational modifications.	K3
CO3: Analyze genetic mutations, recombination mechanisms and genetic mapping techniques used in microbial genetics.	K4
CO4: Explain the molecular biology of bacteriophage λ, including lytic and lysogenic cycles and their genetic regulation.	K3
CO5: Illustrate the mechanisms of horizontal gene transfer and transposable elements and evaluate their significance in microbial evolution.	K4
CO6: Integrate concepts of molecular biology and microbial genetics to solve biological problems and prepare for higher studies, research and competitive examinations.	K5

Suggested Readings:

- Bruce Alberts, Alexander D. Johnson, Julian Lewis, David Morgan, Martin Raff, Keith Roberts,
- *Molecular Cell Biology,* W. W. Norton & Company, 6th Edition, 2014.
- Harvey Lodish, Arnold Berk, Chris A. Kaiser, Monty Krieger, Anthony Bretscher, HiddePloegh, Kelsey Martin, Michael Yaffe, Angelika Amon, Angelika, *Molecular Cell Biology,* 9th Edition,W.H. Freeman, USA., 2021.
- Simmons, Michael J., and Snustad, D. Peter**.** *Principles of Genetics***.** India, Wiley, 2015.
- McGhee, Michelle, et al. *Molecular Biology*. Netherlands, Elsevier Science, 2018.

Online Resources:

- https://nptel.ac.in/courses/102/103/102103015/#
- https://www.pdfdrive.com/biochemistry-genetics-molecular-biology-e18198970.html
- https://sites.google.com/site/microbiologyacu2/home/fall/pharmaceutical-microbiology
- http://fda.gov/downloads/ScienceResearch/FieldScience/UCM397228.pdf
- https://www.wiley.com/en-us/Principles+of+Genetics%2C+7th+Edition-p-9781119142287#E- Book

K1-Remember	K2-Understand	K3-Apply	K4-Analyze	K5-Evaluate	K6-Create

Course designed by: Dr H Noorul Samsoon Maharifa

Course outcome Vs Programme Learning Outcomes

CO	PLO 1	PLO 2	PLO 3	PLO4	PLO 5	PLO6	PLO 7	PLO 8	PLO 9	PLO 10	PLO 11	PLO 12	PLO 13	PLO 14	PLO 15
CO1	3	3	2	2	3	2	1	2	1	2	1	1	1	2	3
CO2	3	3	3	2	3	3	2	2	1	2	1	1	1	2	3
CO3	3	3	3	2	3	2	2	2	1	2	1	1	1	2	3
CO4	3	3	3	2	3	2	2	2	1	2	1	1	1	2	3
CO5	3	3	3	2	3	3	3	3	1	2	2	1	1	3	3
CO6	3	3	3	3	3	3	3	3	2	2	2	2	2	3	3
W.AV	3.00	3.00	2.83	2.17	3.00	2.50	2.17	2.33	1.17	2.00	1.33	1.17	1.17	2.33	3.00

S-Strong (3), M-Medium (2), L-Low (1)

Course outcome Vs Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	3	2	3	1	1	3
CO2	3	3	3	3	1	1	3
CO3	3	3	3	3	2	1	3
CO4	3	2	3	3	2	1	3
CO5	3	3	3	3	2	1	3
CO6	3	3	3	3	2	2	3
W.AV	3.00	2.83	2.83	3.00	1.67	1.17	3.00

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S-Strong (3), M-Medium (2), L-Low (1)

Semester – I					
Course: Core IV	**Course Code:** KMMBC14P	**Course Title:** Lab Course in General Microbiology, Biomolecules and Microbial Physiology, Molecular Biology and Microbial Genetics	**P**	**Credits:5**	**Hours:6**

Unit – I

Objective 1	To acquire laboratory safety practices and develop skills in aseptic techniques, microbial isolation, staining procedures, and biochemical characterization of microorganisms.

1. Laboratory Safety measures
2. Pure culture techniques – Pour plate, Spread plate and Streak plate
3. Isolation and enumeration of microorganisms from soil sources
4. Staining methods – Simple Staining, Gram‟s Staining, Negative staining, Flagella staining, Endospore staining and Lactophenol Cotton Blue staining
5. Biochemical tests: a. IMVIC, b. Catalase, c. Oxidase, d. TSI test, e. ONPG test, f. Nitrate reduction test, g. Starch hydrolysis, h. Gelatin hydrolysis, i. Casein and j. Urease test

Unit – II

Objective 2	To develop competency in media preparation, preparation of laboratory solutions and buffers, pH measurement, and quantitative estimation of carbohydrates.

6. Isolation of Photosynthetic bacteria
7. Preparation of solutions:
   a. pH meter and preparation of buffers of pH range 2 to11
   b. Molarity and Molality calculation
   c. Preparation of 0.1 N acid and base i) NaOH ii) HCl iii) HNO_3
8. Determination of Carbohydrate by DNSA method

Unit – III

Objective 3	To perform biochemical estimation of sugars, amino acids, and proteins using standard laboratory techniques and interpret the experimental findings.

9. Estimation of Total Sugar by Anthrone method
10. Determination of pI value of Amino acids
11. Estimation of Amino acid by Ninhydrin method
12. Estimation of Protein by Lowry‟s and Bradford‟s method

Unit – IV

Objective 4	To isolate, estimate, and analyze biomolecules such as lipids, DNA, and RNA, and perform nucleic acid separation using agarose gel electrophoresis.

13. Estimation of Total Lipids by Folch method
14. Estimation of DNA by Diphenyl Amine method
15. Estimation of RNA by Orcinol method
16. Isolation of genomic DNA and agarose gel electrophoresis

Unit – V

Objective 5	To develop proficiency in advanced laboratory techniques including SDS-PAGE, antibiotic susceptibility testing, paper chromatography, and thin-layer chromatography for biomolecular analysis.

17. Separation of Protein by SDS-PAGE
18. Antibiotic sensitivity assay Kirby Bauer test
19. Separation of Amino acid by Paper Chromatography
20. Separation of Lipids by Thin Layer Chromatography

Unit – VI

Self-Study Components:

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Students shall be encouraged to prepare for competitive examinations such as SET and NET by studying and integrating the concepts covered in the above five units.

Course Outcomes:	**K Level**
CO1: Demonstrate laboratory safety practices, aseptic techniques, microbial isolation, staining methods and biochemical characterization of microorganisms.	K3
CO2: Prepare laboratory reagents, buffers and standard solutions, and perform quantitative estimation of carbohydrates using standard biochemical methods.	K3
CO3: Perform biochemical estimation of sugars, amino acids, proteins and interpret the experimental results accurately.	K4
CO4: Isolate and estimate nucleic acids and lipids, perform agarose gel electrophoresis, and analyze biomolecular separation techniques.	K4
CO5: Apply advanced microbiological and molecular techniques including SDS-PAGE, antibiotic susceptibility testing, paper chromatography and thin-layer chromatography.	K5
CO6: Integrate microbiological, biochemical and molecular biology laboratory skills for scientific investigation, problem solving, research and competitive examinations.	K5

Suggested Readings:

- Shukla Das., Rumpa Saha., *Microbiology Practical Manual,* CBS Publishers and Distributors, First Edition, 2020.
- Karen Adeleman, Frederick M. Ausubel, Roger Brent, David D. Moore, Kevin Struhl, Koen Venken, *Current protocols in Molecular Biology,* John Wiley, 133(1), 2020.
- Talwar G.P., and Gupta S.K., *A Handbook of Practical and Clinical Immunology,* CBS publications, Second Edition, volume 1 and 2, 2017.
- Broun Fred, Edwin, and A. Waksman, Selman. *Laboratory Manual of General Microbiology*.
- with Special Reference to the Microorganisms of the Soil. India, Alpha Editions, 2020.

Online Resources:

- https://www.vlab.co.in/
- http://biotech01.vlabs.ac.in/
- https://nptel.ac.in/courses/102/103/102103017/
- https://www.ncbi.nlm.nih.gov/guide/chemicals-bioassays/
- https://www.pdfdrive.com/bensons-microbiological-applications-laboratory-manual-in-general- microbiology-short-version-e185416575.html

K1-Remember	K2-Understand	K3-Apply	K4-Analyze	K5-Evaluate	K6-Create

Course designed by: : Dr H Noorul Samsoon Maharifa

XXIII ACADEMIC COUNCIL

Course outcome Vs Programme Learning Outcomes

CO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	PLO 11	PLO 12	PLO 13	PLO 14	PLO 15
CO1	3	3	3	2	3	2	2	2	2	3	2	2	1	2	2
CO2	3	3	3	2	3	3	2	2	1	2	1	2	1	2	3
CO3	3	3	3	2	3	2	2	2	1	2	1	2	1	2	3
CO4	3	3	3	2	3	3	2	3	1	2	1	2	1	3	3
CO5	3	3	3	2	3	3	3	3	2	2	2	2	1	3	3
CO6	3	3	3	3	3	3	3	3	2	3	2	2	2	3	3
W.AV	3.00	3.00	3.00	2.17	3.00	2.67	2.33	2.50	1.50	2.33	1.50	2.00	1.17	2.50	2.83

S-Strong (3), M-Medium (2), L-Low (1)

Course outcome Vs Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	3	3	3	3	1	2
CO2	3	3	3	3	2	1	3
CO3	3	3	3	3	2	1	3
CO4	3	3	3	3	2	1	3
CO5	3	3	3	3	2	1	3
CO6	3	3	3	3	3	2	3
W.AV	3.00	3.00	3.00	3.00	2.33	1.17	2.83

S-Strong (3), M-Medium (2), L-Low (1)

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Semester – I					
Course: Discipline Specific Elective I	**Course Code :** KMMBE1A	**Course Title: a.** Algal Technology	**T**	**Credits:5**	**Hours: 6**

Unit – I	
Objective 1	To understand the history, classification, diversity, and distinguishing characteristics of major groups of algae and their biological significance.
Introduction to algae: History of Phycology; Classification of Algae – Fritsch‟s system, G.M.Smith system; Salient features of major classes – Prochlorophyta, Chlorophyta, Cyanophyta, Charophyta, Bacilloriophyta, Xanthophyta, Phaeophyta and Rhodophyta	
Unit – II	
Objective 2	To explain the ultrastructure of prokaryotic and eukaryotic algal cells, modes of reproduction, life cycles, and the ecological significance of eutrophication.
Algal structure, division and growth: Ultrastructure of Prokaryotic and Eukaryotic Algal cells and their components – Cell Wall, Protoplasm, Flagella, Eye Spots, Chloroplast, Pyrenoid, Nucleus, Pigments and Reserve foods; Reproduction – Vegetative, Sexual, Asexual; Life cycle in algae, Eutrophication.	
Unit – III	
Objective 3	To acquire knowledge of indoor and outdoor algal cultivation methods, growth requirements, culture media, and the environmental factors influencing algal growth and productivity.
Algal cultivation: Indoor and Outdoor Cultivation; Nutrients – carbon sources, growth kinetics; Factors affecting algal cultivation – Temperature, Water, Light, Culture depth, Agitation of Algalsuspension, Oxygen transfer, Inoculum size, Evaporation, pH.	
Unit – IV	
Objective 4	To understand various techniques for harvesting, drying, storage, packaging, and processing of algae, and to evaluate the economics of the algal industry.
Algal Processing: Harvesting – Centrifugation, Auto Flocculation, Induced Flocculation, Filtration, Flotation, Microstrainer, Sand Filtration, Ion Exchange Method; Drying – Electrically Heated Drum Drying, Steam Heated Drum Drying, Cross Flow Air Drying, Vacuum Shelf Drying, Solar Drying; Yield, Chemical Composition, Storage and Packaging; Economics of Algal Industry.	
Unit – V	
Objective 5	To explore the industrial, agricultural, environmental, pharmaceutical, and biotechnological applications of algae, including their role in food, feed, biofertilizers, biofuels, wastewater treatment, and cosmetics.
Applications of algae: Therapeutic properties of Microalgae; SCP, Food, animal feed; Fuel; Algal system in Effluent treatment; Role of algae in cosmetics; Biofertilizer – Physiology of nitrogen fixation, Algalization technology and N_2 fixation in symbiosis involving BGA.	
Unit – VI	
Self-Study Components:	
Students shall be encouraged to prepare for competitive examinations such as SET and NET by studying and integrating the concepts covered in the above five units.	

Course Outcomes:	**K Level**
CO1: Explain the classification, diversity and biological significance of algae	K2
CO2: Describe algal cell structure, reproduction, life cycles and eutrophication.	K2
CO3: Demonstration knowledge of algal cultivation methods and factors affecting algal growth	K3
CO4: Explain harvesting, processing, storage and economics of algal industries.	K4

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CO5: Apply knowledge of algae in food, medicine, biofertilizers, biofuels and environmental management.	K5
CO6: Develop problem-solving skills by applying algal biology concepts to competitive examination questions and practical applications.	K5

Suggested Readings:

- Dr. A. K. Kushwaha and Dr. M.K.Shukla, *A Text Book of Algae,* For Degree Students. N.p., Amazon Digital Services LLC - KDP Print US, 2020.
- A.V.S.S. Sambamurty, *A Text Book of Algae,* Dreamtech Press, 2019.
- Santhakumaran, Prasanthkumar, Santhosh K. Kookal, Linu Mathew, and Joseph G. Ray. *"Bioprospecting of Three Rapid-Growing Freshwater Green Algae, Promising Biomass for Biodiesel Production."* Bioenergy Research, 2019.
- Bharath, Gunasekaran, Velmurugan Aswini, and K. M. Gothandam. *"Algae and Food Safety."*
- Algae for Food: Cultivation, Processing and Nutritional Benefits, 2021.

Online Resources:

- https://www. samples.sainsburysebooks.co.uk/9781405172493_sample_380750.pdf
- https://www.lawofalgae.wiki.zoho.com/Chapter-1---------- Introduction-to-Algae-Bi
- https:// www.northinlet.sc.edu/training/media/2012/ ...../Science-of-Algae.pdf
- https:// www.dbs.nus.edu.sg/biofuel2012/ ..... /22%20Borowitzka%20(ok).pdf
- https://www.researchgate.net/publication/230652373_Economic_importance_of_algae

K1-Remember	K2-Understand	K3-Apply	K4-Analyze	K5-Evaluate	K6-Create

Course designed by: Dr H Noorul Samsoon Maharifa

Course outcome Vs Programme Learning Outcomes

CO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	PLO 11	PLO 12	PLO 13	PLO 14	PLO 15
CO1	3	2	1	2	1	1	1	2	1	1	1	2	1	1	2
CO2	3	3	2	2	2	1	1	2	1	1	2	3	1	1	2
CO3	3	3	3	2	3	2	2	3	1	1	2	3	1	2	3
CO4	3	3	3	2	3	2	3	3	2	2	2	3	1	3	3
CO5	3	3	3	2	3	3	3	3	2	2	3	3	1	3	3
CO6	3	3	3	3	3	3	3	3	2	2	2	3	2	3	3
W.AV	3.00	2.83	2.50	2.17	2.50	2.00	2.17	2.67	1.50	1.50	2.00	2.83	1.17	2.17	2.67

S-Strong (3), M-Medium (2), L-Low (1)

Course outcome Vs Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	2	2	2	1	1	2
CO2	3	3	2	2	2	1	2
CO3	3	3	3	3	2	1	3
CO4	3	3	3	3	2	1	3
CO5	3	3	3	3	2	1	3
CO6	3	3	3	3	2	2	3
W.AV	3.00	2.83	2.67	2.67	1.83	1.17	2.67

S-Strong (3), M-Medium (2), L-Low (1)

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Semester – I					
Course: Discipline Specific Elective I	**Course Code:** KMMBE1B	**Course Title:** b. Enzymology	**T**	**Credits: 5**	**Hours: 6**

Unit – I	
Objective 1	To understand the history, classification, nomenclature, purification techniques, and fundamental properties of enzymes.

Introduction to Enzymes: History of Enzymology, properties of enzymes, Classification of enzymes, Enzyme Nomenclature; Isolation and extraction of enzymes, purification of enzymes – Precipitation, Dialysis, Ultra Filtration and Chromatographic techniques; Free energy, Activation energy and Transition energy; Coenzymes.

Unit – II	
Objective 2	To explain enzyme kinetics, catalytic mechanisms, active site models, and the factors influencing enzyme activity.

Enzyme Kinetics: Henry and Michaelis Menten plot, significance of K_m and K_{cat} Lineweaver- Burk plot; Active sites features, Lock and Key Model, Induced Fit Model; Enzyme Catalysis – General principles, Mechanism of action of enzymes – Chymotrypsin and Lysozyme; Factor influencing Enzyme activity – Temperature, pH, Concentration of Enzymes, Substrate and Product; Role of Metal Ions in Enzyme catalysis.

Unit – III	
Objective 3	To understand enzyme specificity and various mechanisms of enzyme inhibition and their biological significance.

Enzyme Specificity & Inhibition: Types of enzyme specificity – Group specific enzymes – relative group and absolute group, Stereospecific enzymes – optical and geometrical; Types of enzyme inhibition – Irreversible inhibitors and Reversible inhibitors – Competitive, Non– competitive & Uncompetitive Inhibitions.

Unit – IV	
Objective 4	To acquire knowledge on enzyme immobilization techniques, reaction kinetics, and industrial applications of immobilized enzymes.

Enzyme Immobilization: Immobilized enzymes – Definition, Characteristics – Principles & Techniques of Immobilization – Adsorption, Covalent Bonding, Entrapment, Cross-Linking, Encapsulation (advantages and disadvantages); Kinetics of immobilized enzyme reactions; Applications of immobilized enzymes.

Unit – V	
Objective 5	To explore recent advances in enzyme technology, including recombinant DNA technology, biosensors, artificial enzymes, bioinformatics, and enzyme engineering.

Recent advances and future prospects in Enzyme Technology: Multienzyme complex and Multifunctional enzymes, Enzymes and recombinant DNA technology, Enzyme Biosensors; Enzyme as diagnostic tools; Synthesis of Artificial enzymes, Enzymes & Bioinformatics, Rational Designing of enzymes – Site Directed Mutagenesis.

Unit – VI

Self-Study Components:

Students shall be encouraged to prepare for competitive examinations such as SET and NET by studying and integrating the concepts covered in the above five units.

Course Outcomes:	**K Level**
CO1: Explain the classification, nomenclature, properties, purification methods, and coenzymes involved in enzymatic reactions.	K2

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CLO2: Interpret enzyme kinetics, catalytic mechanisms, and factors affecting enzyme activity using kinetic models.	K3
CO3: Analyze enzyme specificity and different types of enzyme inhibition in biological systems.	K4
CO4: Apply principles of enzyme immobilization techniques for industrial and biotechnological applications.	K3
CO5: Evaluate recent advances in enzyme technology, recombinant DNA technology, biosensors, and enzyme engineering.	K5
CO6: Apply enzymology concepts to solve analytical and competitive examination-based problems.	K4

Suggested Readings:

- Palanivelu P., *Enzymes, Ribozymes and DNAzymes,* MKU Coop. Press Ltd., Madurai, Twentyfirst Century Publications, 2nd Edition, 2017.
- Khan, M. Y., and Khan, Farha. *Principles of Enzyme Technology.* India, Phi Learning, 2015.
- Nicholes C. Price and Lewis Stevens, *Fundamentals of Enzymology*, Oxford University Press, Third Edition, 2017.
- Baskar, G, K S. Kumar, and K Tamilarasan. *Enzyme Inhibition: Environmental and Biomedical Applications***.** Singapore: Bentham Science Publishers Pte Ltd.,2020.

Online Resources:

- https://www.ikbooks.com/openPdf/9789381141595
- https://www.pdfdrive.com/methods-in-enzymology-e45313687.html
- https://www.worldcat.org/search?q=au%3APhillips%2C+Jo.&qt=hot_author
- https://www.worldcat.org/search?q=au%3AAustin%2C+Rowan.&qt=hot_author
- https://link.springer.com/article/10.1007/BF03245829

K1-Remember	K2-Understand	K3-Apply	K4-Analyze	K5-Evaluate	K6-Create

Course designed by: Dr H Noorul Samsoon Maharifa

Course outcome Vs Programme Learning Outcomes

CO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	PLO 11	PLO 12	PLO 13	PLO 14	PLO 15
CO1	3	2	1	1	2	1	1	1	–	2	–	–	–	2	2
CO2	3	3	3	1	2	2	1	2	–	–	–	–	–	2	2
CO3	3	3	3	1	2	1	1	2	–	2	–	–	–	2	2
CO4	3	3	3	1	3	2	3	3	2	2	2	3	–	3	2
CO5	3	3	3	2	3	3	3	3	1	2	1	2	1	3	3
CO6	3	3	3	2	3	2	2	2	1	2	1	1	1	3	3
W.AV	**3**	**3**	**3**	**2**	**3**	**2**	**2**	**2**	**1**	**2**	**1**	**2**	**1**	**3**	**2**

S-Strong (3), M-Medium (2), L-Low (1)

Course outcome Vs Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	2	1	2	1	1	2
CO2	3	3	2	2	1	1	2
CO3	3	3	2	2	1	1	2
CO4	3	2	3	3	2	1	3
CO5	3	3	3	3	2	2	3
CO6	3	3	3	3	2	2	3
W.AV	3	3	3	3	2	1	3

S-Strong (3), M-Medium (2), L-Low (1)

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Semester – I					
Course: Extra Credit	**Course Code:** KMMBX1	**Course Title:** Life Science for Competitive Examinations	**T**	**Credits: 2**	**Hours:**
Unit – I					
Objective 1	To understand the structure and organization of prokaryotic and eukaryotic cells, cell organelles, and cell division.				
Prokaryotic and Eukaryotic cells: Structure and ultrastructure; Structure and function of organelles – Chloroplast, Mitochondria, Vacuoles, Endoplasmic Reticulum, Golgi Apparatus, Ribosomes & Lysosomes, Nucleus, Nucleolus, Chromatin and Nucleosome; Mitosis and Meiosis.					
Unit – II					
Objective 2	To explain the structure and functions of nucleic acids, proteins, enzymes, and amino acids.				
Structure and synthesis of DNA: Structure of mRNA, t-RNA & r-RNA; Structure of Proteins – Primary, Secondary, Tertiary and Quaternary; General properties of Enzymes and Amino acids.					
Unit – III					
Objective 3	To understand the principles of heredity, chromosomal inheritance, and mutation.				
Concept of heredity and variation: Mendel‟s law of inheritance, Monohybrid Cross, Dihybrid Cross, Test Cross – Chromosomal basis of Inheritance, Incomplete Dominance, Epistasis, Mutation – Types					
Unit – IV					
Objective 4	To explain ecosystem structure, ecological interactions, environmental pollution, and disaster management.				
Ecosystem: Concept, Structure, Function, Producers, Consumers and Decomposers of Ecosystem, Energy Flow, Food Web and Food Chain, Ecological Pyramids; Types of ecosystem; Pollution – Air, Water and Land; Global Warming and Disaster Management.					
Unit – V					
Objective 5	To understand the basic concepts of biotechnology, genetic engineering, cloning vectors, and their applications.				
Definition and scope of biotechnology: Restriction Enzymes, Plasmid – Types, Cloning Vectors-pBR322, Methods of Gene transfer; Application of Genetic Engineering in the field of Agriculture – Herbicide and Pest Resistance plants & Medicine – Production of Recombinant Vaccines					
Unit – VI					
Self-Study Components:					
Students shall be encouraged to prepare for competitive examinations such as SET and NET by studying and integrating the concepts covered in the above five units.					
Course Outcomes:					**K Level**
CO1: Recall the basic structures and functions of cells, organelles, and cell division.					K1
CO2: Explain the structure and functions of DNA, RNA, proteins, enzymes, and amino acids.					K2
CO3: Apply the principles of genetics, inheritance, and mutations to solve biological problems.					K3
CO4:Analyse ecosystem structure, ecological principles, pollution, and environmental management practices.					K4
CO5: Evaluate the applications of biotechnology and genetic engineering techniques in agriculture and medicine.					K5
CO6: Design integrated solutions to competitive examination-oriented life science problems using multidisciplinary concepts.					K6
Suggested Readings: • Jeffrey C. Pommerville, *Fundamentals of Microbiology,* Jones & Bartlett Learning, 12th					

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Edition, 2021.
- Weathers, Kathleen C., David L. Strayer and Gene E. Likens, eds. *Fundamentals of Ecosystem Science,* Elsevier, 2021.
- Nelson D.L. and Cox M.M., *Lehninger Principles of Biochemistry*, Macmillan worth Publishers, 8th edition, 2021.
- Pelczar Jr. M.J., Chan E.C.S. and Kreig N.R., *Microbiology*, Mc. Graw Hill, 2021.

Online Resources:

- https://www.ugc.ac.in/oldpdf/modelcurriculum/env.pdf
- https://www.academia.edu/38901234/Prescott_Harley_Kleins_Microbiology_7th
- https://kupdf.net/download/cell-biology-genetics-molecular-biology-evolution-and- ecology-verma-agarwal-2005_58fc9b38dc0d606b38959eeb_pdf
- https://pdf.wecabrio.com/fermentation-microbiology-and-biotechnology.pdf

K1-Remember	K2-Understand	K3-Apply	K4-Analyze	K5-Evaluate	K6-Create

Course designed by: Dr H Noorul Samsoon Maharifa

Course outcome Vs Programme Learning Outcomes

CO	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	PLO 11	PLO 12	PLO 13	PLO 14	PLO 15
CO1	3	2	2	1	1	1	1	2	1	1	1	1	1	1	2
CO2	3	2	2	1	2	1	1	2	1	1	1	1	1	1	2
CO3	3	3	3	1	2	1	1	2	1	1	1	1	1	2	3
CO4	3	3	3	2	2	1	2	3	1	2	3	3	1	2	3
CO5	3	3	3	2	3	3	3	3	1	2	2	2	1	3	3
CO6	3	3	3	2	2	2	2	3	1	1	1	2	1	3	3
W.AV	3.00	2.67	2.67	1.50	2.00	1.50	1.67	2.50	1.00	1.33	1.50	1.67	1.00	2.00	2.67

S-Strong (3), M-Medium (2), L-Low (1)

Course outcome Vs Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	2	2	2	1	1	2
CO2	3	2	2	2	1	1	2
CO3	3	3	2	3	1	1	2
CO4	3	3	3	2	2	1	2
CO5	3	3	3	3	2	2	3
CO6	3	3	3	3	2	2	3
W.AV	3.00	2.67	2.50	2.50	1.50	1.33	2.33

S-Strong (3), M-Medium (2), L-Low (1)

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B Sc Microbiology

[Three Years Regular Programme]

(For Students Admitted from 2026-2027

Programme Specific Outcomes:

On completion of the Undergraduate Programme, the student will be able to gain

PSO1	Gain both theoretical and practical knowledge in the fields of microbiology.
PSO2	Inculcate the knowledge of the relationship between microorganisms and human.
PSO3	Expertise in the techniques, which is the base for gaining scientific knowledge and insight about the subject.
PSO4	Aware of their role and responsibility in handling and use of microbes.
PSO5	Apply advanced microbiological and biotechnological techniques to solve complex biological problems.
PSO6	Integrate research, innovation, and emerging technologies to address contemporary microbiological challenges.
PSO7	Enhance the excitement to become independent lifelong learners.

PREAMBLE

The changes carried out in the curriculum are as follows:

- SEC I : Lab course in Microbial Biochemistry - The following changes were made - Anthrone Test & Fehling's Test were added under Qualitative analysis of carbohydrates, Biuret Test & Ninhydrin Test were added under the Tests for proteins, Millon's Test & Ehrlich Test were added under the Tests on amino acids, Saponification Test & Solubility Test were added under the Qualitative tests for lipids and Phenols - Ferric Chloride Test, Quinones - Sulfuric Acid Test, Tannins - Ferric Chloride Test, Flavonoids - Alkaline Reagent Test, Terpene & Terpenoids - Salkowski's Test (Terpenes), Steroids - Lieberman-Burchard Test, Saponins – Froth Test & Alkaloids - Mayer's Test were added under the Phytochemical/Bioactive compounds analysis.
- AECC II: Introduction to Virology – The following modification has been made in Unit V: SARS, Corona Virus has been revised to SARS-CoV, MERS-CoV, and SARS-CoV-2 (COVID-19).

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PROGRAMME CODE: UMB

PROGRAMME STRUCTURE

B Sc MICROBIOLOGY 2026-27

S. No.	Course Code	Course	Title of the Course	T/P	SD | ENT | EMP	REG| NAT| GLO	Credits	Hours/ Week	Marks		
									I	E	Total
			I Semester								
1	KBLTII/ KBLA11/ KBLH11	Language I	Ilakkiyangalum Koyirkalaiyum	T	SD | ENT| EMP	REG | GLO	3	5	40	60	100
			Basic Arabic I			REG | NAT | GLO					
			General Hindi I			REG | NAT| GLO					
2	KBLEB12 / KBLEA12	Language II	English for Everyday Communication (Basic)/ Literature and Language for Life (Advanced)	T	SD | ENT | EMP	REG | NAT | GLO	3	5	40	60	100
3	KBMBC11	Core I	Fundamentals of Microbiology	T	SD | ENT | EMP	REG | NAT | GLO	6	6	40	60	100
4	KBMBC12P	Core II	Lab Course in Fundamentals of Microbiology	P	SD | ENT | EMP	REG | NAT | GLO	5	6	40	60	100
5	KBMBA13	AECC I	Biochemistry	T	SD | ENT | EMP	REG | NAT | GLO	4	4	40	60	100
6	KBMBS14P	SEC I	Lab Course in Biochemistry	P	SD | ENT | EMP	REG | NAT| GLO	1	2	-	50	50
7			Library/Browsing		SD	REG | NAT | GLO	-	1	-	-	-
8			Games		SD	REG | NAT | GLO	-	1	-	-	-
			Total				22	30	**200**	**350**	**550**
			II Semester								
1	KBLT21/ KBLA21/ KBLH21	Language I	காப்பிய இலக்கியமும் புதினமும்	T	SD | ENT | EMP	REG | GLO	3	5	**40**	**60**	**100**
			Basic Arabic II		SD | ENT | EMP	REG | NAT | GLO					
			General Hindi II (Basic) / Hindi Prose, Poem & Story (Advanced)		SD | ENT | EMP	REG | NAT | GLO					

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2	KBLEB22/ KBLEA22	Language II	Part II – English for Academic and Social Interaction (Basic) & Critical Reading and Reflective Writing (Advanced)	T	SD | ENT | EMP	REG | NAT| GLO	3	5	40	60	100
3	KBMBC21	Core III	Microbial Physiology	T	SD | EMP	REG | NAT| GLO	5	5	40	60	100
4	KBMBC22P	Core IV	Lab Course in Microbial Physiology	P	SD | EMP	REG | NAT | GLO	4	5	40	60	100
5	KBMBA23	AECC II	Introduction to Virology	T	SD | EMP	REG | NAT| GLO	4	4	40	60	100
6	KBMBS24P	SEC II	Basics in Bioinformatics Practicals	T	SD | EMP	REG | NAT | GLO	1	2	-	50	50
7	KBUI2V	CVAC I	Understanding India	T	ENT | EMP	REG | NAT | GLO	2	2	-	50	50
8			Library/Browsing					1	-	-	-
9			Games					1	-	-	-
10	KBMBX2/ KBMBX2O	Extra Credit I	Cell Biology /SWAYAM Course				2	-	-	100	100
			Total				22+2	30	**200**	**400+ 100**	**600+ 100**
			III Semester								
1	KBLT31/ KBLA31/ KBLH31	Language I	**இடைக்கால இலக்கியமும் இதழியலும்**	T	SD | ENT | EMP	REG | NAT | GLO	3	5	40	60	100
			Classical Arabic Prose		SD | ENT | EMP	REG| NAT | GLO					
			General Hindi III (Basic)/ Hindi Literature & Letter writing (Advanced)		SD | ENT | EMP	REG | NAT | GLO					
2	KBLEB32/ KBLEA32 KBLEB32/ KBLEA32	Language II	Part II – Workplace English: Foundations of English Communication Skills (Basic) / English for the Corporate World (Advanced)	T	SD | ENT | EMP	REG | NAT | GLO	3	5	40	60	100
3	KBMBC31	Core V	Molecular Biology	T	SD | EMP	REG | NAT | GLO	4	4	40	60	100
4	KBMBC32P	Core VI	Lab Course in Molecular Biology	P	SD | EMP	REG | NAT | GLO	3	4	40	60	100
5	KBMBA33	AECC III	Bioethics, Biosafety, Intellectual Property Rights and Bioentrepreneurship	T	SD | ENT | EMP	REG | NAT | GLO	4	4	40	60	100
6	KBMBS34P	SEC III	Lab course in Biofertilizers Production	P	SD | ENT | EMP	REG | NAT | GLO	1	2	-	50	50
7	KBDB31MBP	MD I	Lab Course in Mushroom Cultivation	P	SD | ENT | EMP	REG | NAT | GLO	1	2	-	50	50

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8	KBES3V	CVAC II	Environmental Studies for Sustainable Development	T	SD | ENT | EMP	REG | NAT | GLO	2	2	-	50	50
9	KBXTN3	Extension	NSS / CSS		SD | ENT | EMP	REG | NAT | GLO	2	2	100	-	100
10	KBMBX3/ KBMBX3O	Extra Credit II	Developmental Biology / SWAYAM Course		SD | EMP	REG | NAT | GLO	2	-	-	100	100
			Total				23+2	30	**300**	**450+ 100**	**750+ 100**
			IV Semester								
1	KBLT41/ KBLA41/ KBLH41	Language I	பண்டைய இலக்கியமும் நாடுப்புறப் பாடல்களும்	T	SD | ENT | EMP	REG | GLO	3	5	40	60	100
			Hadeeth		SD | ENT | EMP	REG | NAT | GLO					
			General Hindi IV (Basic) / Computer and Hindi (Advanced)		SD | ENT | EMP	REG | NAT | GLO					
2	KBLEB42/ KBLEA42	Language II	Part II – Professional Communication Skills (Basic) & Strategic Communication for Global Careers (Advanced)	T	SD | ENT | EMP	REG | NAT | GLO	3	5	40	60	100
3	KBMBC41	Core VII	Microbial Genetics	T	SD | ENT | EMP	REG | NAT | GLO	5	5	40	60	100
4	KBMBC42	Core VIII	Medical Microbiology and Biotherapeutics	T	SD | ENT | EMP	REG | NAT | GLO	4	4	40	60	100
5	KBMBA43	AECC IV	Bioinstrumentation and Biostatistics	T	SD | ENT | EMP	REG | NAT | GLO	4	4	40	60	100
6	KBMD41MBP	MD II	Lab Course in Vermiculture	P	SD | ENT | EMP	REG | NAT | GLO	2	3	-	50	50
7	KBMBS44P	SEC IV	Lab course in Medical lab Technology	P	SD | ENT | EMP	REG | NAT | GLO	1	2	-	50	50
8	KBDT4V	CVAC III	Digital and technology solution	T	SD | ENT | EMP	REG | NAT | GLO	2	2	-	50	50
9	KBMBX4/ KBMBX4O	Extra Credit III	Microbes in Human Welfare /*Online Course				2	-	-	100	100
			Total				24+2	30	**200**	**450+ 100**	**650+ 100**
			V Semester								
1	KBMBC51	Core IX	Environmental and Agricultural Microbiology	T	SD | ENT | EMP	REG | NAT | GLO	6	6	40	60	100
2	KBMBC52	Core X	Immunology	T	SD | ENT | EMP	REG | NAT | GLO	6	6	40	60	100
3	KBMBC53P	Core XI	Lab Course in Environmental, Agricultural Microbiology	P			4	6	40	60	100

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			and Immunology		SD | ENT | EMP	REG | NAT | GLO					
4	KBMD51MBA/ KBMD51MBB	MD III	a. Marine Microbiology b. Biotechnological Techniques	T	SD | ENT | EMP	REG | NAT | GLO	3	4	40	60	100
5	KBMD52MBA/KBMD52MBB	MD IV	a. Computational Drug Designing b. Bionanotechnology	T	SD | ENT | EMP	REG | NAT | GLO	3	4	40	60	100
6	KBMBS54P	SEC V	Lab course in Aquaculture	P	SD | ENT | EMP	REG | NAT | GLO	1	2	-	50	50
7	KBHW5V	CVAC IV	Health and wellness	T	SD | ENT | EMP	REG | NAT | GLO	2	2	-	50	50
8	KBESX5	Extra Credit IV	Employability Skills	T	SD | ENT | EMP	REG | NAT | GLO	2	-	100	-	100
			Total				25+2	30	**200 +10 0**	**400**	**600+ 100**
			VI Semester								
1	KBMBC61	Core XII	Food Microbiology	T	SD | ENT | EMP	REG | NAT | GLO	6	6	40	60	100
2	KBMBC62	Core XIII	Industrial Microbiology	T	SD | ENT | EMP	REG | NAT | GLO	6	6	40	60	100
3	KBMBC63P	Core XIV	Lab Course in Microbial Genetics, Food, Industrial and Medical Microbiology	P	SD | ENT | EMP	REG | NAT | GLO	4	6	40	60	100
4	KBMBC64PW	Core XV	Project	P	SD | ENT | EMP	REG | NAT | GLO	4	5	40	60	100
5	KBMD65MB	MD V	Public Health and Hygiene	T	SD | ENT | EMP	REG | NAT | GLO	3	4	40	60	100
6	KBMBS66	SEC VI	Scientific writings for Life Science Research Practicals	T	SD | ENT | EMP	REG | NAT | GLO	1	2	-	50	50
7	KBMBX6/ KBMBX6O	Extra Credit V	Life science for competitive examination / *Online Course	T	EMP	NAT	2	-	-	100	100
8			Library / Browsing				-	1	-	-	-
			Total				25+2	30	**200**	**350+ 100**	**550+ 100**
			Grand Total				140+ 10	360	**130 0 + 100**	**2400 +400**	**3700 + 500**

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Multidisciplinary Courses offered to the other Departments

S. No.	Semester	Title of the Paper	T / P	SD | ENT | EM	REG| NAT |GLO	Credits	Hours/ Week	Marks		
								I	E	Total
IV	III	Lab Course in Mushroom Cultivation	P	SD | ENT | EMP	REG | NAT | GLO	1	2	-	50	50
III	IV	Lab Course in Vermiculture	P	SD | ENT | EMP	REG | NAT | GLO	2	3	-	50	50
IV	V	a. Marine Microbiology b. Biotechnological Techniques	T	SD | ENT | EMP	REG | NAT | GLO	3	4	40	60	100
IV	V	a. Computational Drug Designing b. Bionanotechnology	T	SD | ENT | EMP	REG | NAT | GLO	3	4	40	60	100
IV	VI	Public Health and Hygiene	T	SD | ENT | EMP	REG | NAT | GLO	3	4	40	60	100

H/W – Hours / Week, CIA – Continuous Internal Assessment, ESE – End Semester Examination

* For online certification credit alone will be assigned on submission of certificate obtained through appearing for online examination from spoken tutorial, EDX, NPTEL or Coursera and other MHRD MOOCs

Courses:

I Semester = 22 Credits (Part I: 3; Part II: 3; Core: 11; Ability Enhancement Compulsory Course I: 4; Skill Enhancement Course I:1)

II Semester = 22 Credits (Part I: 3; Part II: 3; Core: 9; Ability Enhancement Compulsory Course II: 4; Skill Enhancement Course II:1; Common Value Added Course I:2)

III Semester = 23 Credits (Part I: 3; Part II: 3; Core: 7; Ability Enhancement Compulsory Course III: 4; Skill Enhancement Course III:1; Multidisciplinary Course I:1; Common Value Added Course II:2; NSS :2)

IV Semester = 24 Credits (Part I: 3; Part II: 3; Core: 9; Ability Enhancement Compulsory Course III: 4; Skill Enhancement Course IV: 1; Multidisciplinary Course II: 2; Common Value Added Course III:2)

V Semester = 25 Credits (Core: 16; Skill Enhancement Course V: 1; Multidisciplinary Course III: 3; Multidisciplinary Course IV: 3; Common Value Added Course IV:2)

VI Semester = 24 Credits (Core: 20; Skill Enhancement Course VI: 1; Multidisciplinary Course V: 3)

Total credits = 140+Extra credits (10)

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Semester – I					
Course: Core I	**Course Code:** KBMBC11	**Course Title:** Fundamentals of Microbiology	**T**	**Credits: 6**	**Hours: 6**

Unit – I

Objective 1	To understand the history, scope, classification, and contributions of pioneers in microbiology.

Introduction and History of Microbiology: Introduction – Definition, Scope and History of Microbiology; Classification of Microorganisms – General Principles and Nomenclature – Haeckel's three kingdom concept, Whittaker's five kingdom concept; Contributions of Antonie Van Leeuwenhoek, Edward Jenner, Spallanzani, Robert Hook, Louis Pasteur, Robert Koch and John Needham.

Unit – II

Objective 2	To learn the principles and applications of microscopy and microbial classification.

Microscopy and Classification of Microorganisms: Microscopy – Simple and Compound Microscopes , Bright field, Dark field, Phase contrast, Fluorescence and Electron Microscopes (SEM & TEM). Introduction to Bergy's Manual, Archaea, Bacteria, Eukarya, and Actinomycetes.

Unit – III

Objective 3	To gain knowledge on sterilization methods and preparation of microbiological media.

Sterilization and Microbiological Media: Sterilization – Physical methods of sterilization – Dry & moist heat, Filtration: Chemical methods of sterilization, Sterilizing gases, Preparation of microbiological media, Types of Media.

Unit – IV

Objective 4	To study the structure and functions of prokaryotic and eukaryotic cells.

Structure and Function of Prokaryotic and Eukaryotic Cells: Prokaryotes and Eukaryotes – Anatomy of Prokaryotes and Eukaryotes, Ultrastructure and function of the Capsule, Slime layer, Cell wall, Cytoplasmic membrane, Cilia, Flagella, Pili, Endospore, Genetic material and Plasmid. Difference between Prokaryotic and Eukaryotic cells. Mycoplasma.

Unit – V

Objective 5	To understand the characteristics, cultivation, and economic importance of fungi and algae.

Mycology and Phycology: Mycology – General characteristics of fungi, Habitat, and Morphology, Reproduction and Fruiting bodies, Types of spores. Biological and economic importance of fungi (*Aspergillus niger, Agaricus bisporus*).

Phycology – General characteristics of Algae, Habitat, Morphology, Pigments and reproduction, Biological and economic importance of Algae (Cyanobacteria - *Spirulina*). Introduction on Lichens, Cultivation of fresh water and marine algae.

Course Outcome	**K Level**
CO1: Understand and explain the fundamental concepts, principles, and applications of microbiology.	K1- K2
CO2: Demonstrate knowledge of microbial classification, microscopy, sterilization, cell structure, fungi, and algae.	K3
CO3: Analyze the structure, function, characteristics, and importance of microorganisms.	K4
CO4: Apply microbiological concepts, laboratory techniques, and microbial knowledge in academic and practical fields.	K3
CO5: Evaluate the biological, environmental, medical, and industrial significance of microorganisms.	K5
CO6: Develop scientific understanding, technical skills, and problem-solving abilities related to microbiology.	K6

Suggested Readings:

- Ananthanarayan. R. and Paniker C.K., Text Book of Microbiology, Orient Longman, 11th Edition, 2020.
- Black J.G., Microbiology: Principles and Explorations, John Wiley & Sons Ltd, 9th Edition, 2015.
- Jeffrey C Pommerville. Fundamentals of Microbiology, MA Jones & Bartlett Learning. 12th Edition,

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2022.
- Jeffrey C. Pommerville, Alcamo‟s Fundamentals of Microbiology, Jones and Bartlett publishers, Massachusetts, 10th Edition, 2017.
- Lansing M. Prescott, John P. Harley and Donald A. Klein‟s, Microbiology, 10th Edition, McGraw-Hill, 2015.
- Pelczar, Chan & Kreig, Microbiology, Tata McGraw Hill, New Delhi., 5th Edition, 2012.

Online Resources:

- https://nptel.ac.in/courses/102/103/102103015/#
- https://bio.libretexts.org/Bookshelves/Microbiology
- http://www.bamu.ac.in/Portals/0/B_Sc_Microbiology_I_Year_Sem_I_&_II.pdf
- https://nzetc.victoria.ac.nz/tm/scholarly/tei-Bio13Tuat02-t1-body-d2.html
- https://courses.lumenlearning.com/boundless-biology

K1-Remember	K2-Understand	K3-Apply	K4-Analyze	K5-Evaluate	K6-Create

Course designed by: Dr H Noorul Samsoon Maharifa

Course outcome Vs Programme Learning Outcomes

CO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CO1	3	3	2	2	2	2	2	1	1	1	1	1
CO2	3	3	3	2	2	2	2	2	1	1	1	1
CO3	2	3	3	3	2	2	2	2	1	1	1	1
CO4	3	3	3	3	3	2	2	2	2	1	1	1
CO5	2	2	3	2	3	2	2	2	2	1	1	1
CO6	3	3	3	3	3	3	2	2	2	2	1	1
W.AV	2.7	2.8	2.8	2.5	2.5	2.2	2.0	1.8	1.5	1.2	1.0	1.0

S-Strong (3), M-Medium (2), L-Low (1)

Course outcome Vs Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	**3**	**2**	**2**	**1**	**1**	**1**	**1**
CO2	**3**	**3**	**2**	**2**	**1**	**1**	**1**
CO3	3	**3**	**3**	**2**	**2**	**1**	**1**
CO4	**3**	**3**	**3**	**3**	**2**	**2**	**1**
CO5	**2**	3	**3**	**2**	**3**	**2**	**2**
CO6	**3**	**3**	**3**	**3**	**3**	**2**	**2**
W.AV	3.0	2.8	2.7	2.2	2.0	1.5	1.3

S-Strong (3), M-Medium (2), L-Low (1)

Semester – I					
Course: CORE II	**Course Code:** KBMBC12P	**Lab Course Title:** Lab Course in Fundamentals of Microbiology	**P**	**Credits: 5**	**Hours: 6**
UNIT I					
Objective 1	To understand laboratory safety practices, microbiological equipment, sterilization methods, and media preparation techniques.				

1. Rules and precautions of microbiology laboratory
2. Equipment needed for microbiology laboratory
3. Types of culture media
4. Sterilization methods: Heat, Moist, radiation and chemical

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5. Calculations in media preparations	
UNIT II	
Objective 2	To develop skills in preparing culture media and isolating pure microbial cultures using standard microbiological techniques.
6. Preparation of media for the culture of microorganisms: a. Liquid (Nutrient Broth) b. Solid (Stab and slant) **7. Pure culture methods:** a. Pour plate b. Spread plate c. Streak plate – simple, zigzag, T streak, quadrant and radiant	
UNIT III	
Objective 3	To study the cultural characteristics and quantitative estimation of microorganisms using serial dilution methods.
8. Cultural characteristics of Bacteria and Fungi. **9.** Enumeration of Bacteria &Fungi by serial dilution technique	
UNIT IV	
Objective 4	To understand microbial staining techniques, motility testing, and microscopic observation of microorganisms.
10. Staining methods for microorganisms: a. Simple staining b. Grams staining c. Capsular staining d. Acid fast staining e. Lactophenol cotton blue staining f. Endospore staining **11.** Wet mount preparation of protozoa **12.** Bacterial motility – Hanging drop method	
UNIT V	
Objective 5	To identify and study the structural characteristics of cyanobacteria and fungi using permanent slide observations.
13. Observation of permanent slides to study the structural characteristics of Microalgae and fungi a. Cyanobacteria – *Oscillatoria, Nostoc, Anabaena* b. Fungi – *Aspergillus, Penicillium, Rhizopus,* Yeast	

Course Outcome	**K Level**
CO1: Explain the fundamental principles of microbiology laboratory practices, including laboratory safety, sterilization methods, culture media, microbial cultivation, staining techniques, and microscopic observations of microorganisms.	K2
CO2: Demonstrate the preparation of culture media, aseptic handling, sterilization procedures, and pure culture techniques used in microbiological analysis.	K3
CO3: Apply microbiological techniques for the isolation, cultivation, enumeration, staining, and motility determination of bacteria, fungi, protozoa, and cyanobacteria.	K3
CO4: Analyze the cultural, morphological, physiological, and staining characteristics of microorganisms through laboratory experiments and microscopic examination.	K4
CO5: Evaluate different microbiological methods used for microbial identification, enumeration, staining, and structural characterization of microorganisms.	K5

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CO6: Develop practical competency in microbiological laboratory techniques for the identification, classification, and interpretation of microbial structures and characteristics.	K6

Suggested Readings:

- Aneja K. R., Experiments in Microbiology, Plant Pathology and Tissue Culture and Microbial Biotechnology, Wishwa Prakashan, New Delhi, 5th Edition,2018.
- Fischbach F.T. and Dunning M.B., A Manual of Laboratory and Diagnostic Tests, Lippinocott Williams and Wilkins, Baltimore,11th Edition, 2021.
- James G Cappuccino and Chand Welsh., Microbiology – A Laboratory Manual, Harlow, England Pearson,2018.
- Jeffrey C. Pommerville, Alcamo‟s. Fundamentals of Microbiology Jones and Bartlett publishers, Massachusetts, 10th Edition, 2017.
- Jeffrey C. Pommerville, Fundamental of Microbiology + Laboratory Fundamentals of Microbiology, [S.I]: Jones & Bartlett Learning, 2021.

Online Resources:

- https://mvi-au.vlabs.ac.in/
- http://amrita.vlab.co.in/?sub=3&brch=76
- https://www.vlab.co.in/
- https://www.cdc.gov/infectioncontrol/guidelines
- https://labmonk.com/to-study-bacterial-motility-by-using-hanging-drop-technique

K1-Remember	K2-Understand	K3-Apply	K4-Analyze	K5-Evaluate	K6-Create

Course designed by: Dr H Noorul Samsoon Maharifa

Course outcome Vs Programme Outcomes

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14	PO 15
CO1	3	1	1	2	1	1	1	3	1	1	2	1	3	1	2
CO2	3	1	2	3	2	2	2	3	2	1	2	1	3	2	2
CO3	3	2	3	3	3	3	2	3	2	1	2	1	2	2	2
CO4	3	2	3	3	3	3	2	3	3	1	2	1	2	2	2
CO5	3	2	3	3	3	3	2	3	3	2	2	1	2	2	3
CO6	3	2	3	3	3	3	2	3	3	2	3	2	3	2	3
W.AV	3.0	1.7	2.5	2.8	2.5	2.5	1.8	3.0	2.3	1.3	2.2	1.2	2.5	1.8	2.3

S-Strong (3), M-Medium (2), L-Low (1)

Course outcome Vs Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	2	2	3	1	1	2
CO2	3	3	3	3	1	2	2
CO3	3	3	3	2	2	3	2
CO4	3	3	3	3	2	3	2
CO5	3	3	3	3	3	3	3
CO6	3	3	3	3	3	3	3
W.AV	3.0	2.8	2.7	2.8	2.0	2.5	2.3

S-Strong (3), M-Medium (2), L-Low (1)

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Semester – I					
Course: SEC I	**Course Code:** KBMBS14P	**Lab Course Title:** Lab Course in Biochemistry	**P**	**Credits: 1**	**Hours: 2**
UNIT I					
Objective 1	To understand laboratory safety procedures, preparation of buffer solutions, and pH measurement techniques used in biochemistry laboratories.				
1. Rules and Procedures of General Safety **2.** Buffer solution preparation and pH measurement					
UNIT II					
Objective 2	To perform qualitative analysis of carbohydrates and proteins using standard biochemical test methods.				
3. Qualitative analysis of carbohydrates a. Benedict Test b. Fehling's Test **4.** Tests for proteins a. Biuret Test b. Ninhydrin Test					
UNIT III					
Objective 3	To identify amino acids and lipids using qualitative biochemical assays and analytical techniques.				
5. Tests on amino acids a. Millon's Test b. Ehrlich Test 6. Qualitative tests for lipids a. Saponification Test b. Solubility Test					
UNIT IV					
Objective 4	To analyze major phytochemical compounds such as phenols, quinones, tannins, and flavonoids using qualitative screening methods.				
7. Phytochemical/Bioactive compounds analysis a. Phenols - Ferric Chloride Test b. Quinones - Sulfuric Acid Test c. Tannins - Ferric Chloride Test d. Flavonoids - Alkaline Reagent Test					
UNIT V					
Objective 5	To identify bioactive compounds including terpenes, steroids, saponins, and alkaloids through standard phytochemical tests.				
7. Phytochemical/Bioactive compounds analysis e. Terpene & Terpenoids - Salkowski's Test (Terpenes) f. Steroids - Lieberman- Burchard Test g. Saponins – Froth Test h. Alkaloids - Mayer's Test					

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Course Outcome	K Level
CO1: Explain the fundamental principles, laboratory safety procedures, buffer preparation, pH measurement, biochemical assays, and phytochemical analysis involved in biochemistry laboratory practices.	K2
CO2: Demonstrate qualitative analysis of carbohydrates, proteins, amino acids, lipids, and phytochemical compounds using standard biochemical laboratory techniques.	K3
CO3: Apply biochemical methods for the identification, characterization, and analysis of biomolecules and bioactive compounds through experimental procedures.	K3
CO4: Analyze biochemical reactions, test observations, colorimetric changes, and qualitative screening results obtained during biochemical and phytochemical investigations.	K4
CO5: Evaluate the effectiveness, significance, and applications of biochemical and phytochemical techniques used for biomolecule identification and analysis.	K5
CO6: Develop technical competency in biochemical experimentation, interpretation of analytical results, and systematic identification of biomolecules and phytochemicals through laboratory investigations.	K6

Suggested Readings:

- Albert L. Lehninger, David L. Nelson and Michael M. Cox. Lehninger, Principles of Biochemistry, 2nd edition, Wiley publisher. 2010.
- Deb A.C., Fundamentals of Biochemistry, 10th edition, New Central Book Agency (p) ltd, London. 2011.
- Keith Wilson and John Walker, Principles and Techniques of Practical Biochemistry, 4th edition, Cambridge University press, Britain. 1995.
- Shawn O' Farrell and Ryan T Ranallo, Experiments in Biochemistry: A Hands-on Approach-A manual for the undergraduate laboratory, Thomson Learning, Inc., Australia. 2000.
- Strolv B.A., Makavora V.C., Laboratory manual in Biochemistry. MIR Publisher, Moscow. 1989. Oser BL Hawks. Physiological Chemistry, TATA Mc Graw Hill. 1965.

Online Resources:

- Onlinelearning.hms.harvad.edu/biochemistry
- Aldrin.tripod.com/biochemistry
- https://study.com/biochemistry-class-online.html
- Canterbury.libguides.com/bchm/websites

K1-Remember	K2-Understand	K3-Apply	K4-Analyze	K5-Evaluate	K6-Create

Course designed by: Dr H Noorul Samsoon Maharifa

Course outcome Vs Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PO13	PO14	PO15
CO1	3	2	2	3	2	1	1	3	1	1	2	1	3	1	2
CO2	3	2	3	3	2	2	2	3	2	1	2	1	3	1	2
CO3	3	3	3	3	3	3	2	3	2	1	2	1	2	2	2
CO4	3	3	3	3	3	3	2	3	3	1	2	1	2	2	2
CO5	3	3	3	3	3	3	2	3	3	2	2	1	2	2	3
CO6	3	3	3	3	3	3	2	3	3	2	2	2	3	2	3
W.AV	3.0	2.7	2.8	3.0	2.7	2.5	1.8	3.0	2.3	1.3	2.2	1.2	2.5	1.7	2.3

S-Strong (3), M-Medium (2), L-Low (1)

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Course outcome Vs Programme Specific Outcomes

CO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	2	2	3	1	1	2
CO2	3	2	3	3	1	2	2
CO3	3	2	3	2	2	3	2
CO4	3	2	3	2	2	3	2
CO5	3	2	3	2	2	3	3
CO6	3	3	3	3	2	3	3
W.AV	3.0	2.2	2.8	2.5	1.7	2.5	2.3

S-Strong (3), M-Medium (2), L-Low (1)

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