SEMESTER V
COURSE 6 APPLIED MICROBIOLOGY
Theory | Credits: 3 | Total teaching hours: 45

I Course Outcomes

By the completion of the course, the learner should be able to:

CO1. Identify areas of entrepreneurship and assess the scope for establishing an enterprise.

CO2. Explain the production of fermentation products and their economics.

CO3. Explain the production methods of biofertilisers and mushrooms.

CO4. Explain the processes of baking and brewing.

CO5. Prepare a Detailed Project Report (DPR) and understand patenting.

Activity Implementation

The activities listed under each unit provide options for classroom and independent learning. The instructor shall select and schedule appropriate activities, communicate the expected submission and assessment criteria in advance, and provide feedback. Activity time shall be planned within the course delivery and independent study schedule; the theory allocation remains nine hours per unit.

II Syllabus of Theory

Unit 1 Entrepreneurial Skills

Teaching hours: 9 | Related course outcomes: CO1

1.1 Entrepreneurial skills – institutes involved, government support to entrepreneurs, incubation centres and risk assessment.

1.2 Scope for small-, medium- and large-scale industries in microbiology.

1.3 Indian universities and companies involved in the production of biofertilisers and biopesticides.

Suggested Learning Activities

Activity	Task	Expected submission
Assignment	Map entrepreneurship opportunities in microbiology. Compare three possible enterprises by target customers, resources, infrastructure and major risks.	A comparison chart and a brief justification of the preferred opportunity.
Seminar	Present the role of an incubation centre or support institution in developing a microbiology enterprise, using current official sources.	A 5–7 minute presentation with source links and access dates.
Quiz	Identify entrepreneurial skills and distinguish market, technical and financial risks through brief business scenarios.	A 20-mark individual quiz.
Project	Prepare a desk-based feasibility profile for a proposed microbiology enterprise. Include a directory of relevant Indian universities, companies and support institutions.	A short feasibility report with verified sources and clearly stated assumptions.

Activity	Task	Expected submission
Peer teaching	Explain risk assessment using a fictional microbiology start-up and a simple likelihood–impact matrix.	A 5-minute lesson, risk matrix and three check questions.

Evaluation

The instructor shall prepare a dedicated rubric for each selected activity before implementation, adapting the activity-specific criteria in Section VI to the task. Share the rubric and maximum marks with students, assess the submitted evidence and individual contribution, and record feedback and marks.

Unit 2 Fermentation Products

Teaching hours: 9 | Related course outcomes: CO2

2.1 Microbial cells as fermentation products.

2.2 Baker’s yeast, food and feed yeasts, single-cell protein (SCP), bacterial insecticides, legume inoculants and algae.

2.3 Enzymes as fermentation products – bacterial and fungal amylases, proteolytic enzymes, pectinases, invertases and other enzymes.

2.4 Fermentation economics.

Suggested Learning Activities

Activity	Task	Expected submission
Assignment	Classify the listed fermentation products as microbial biomass, inoculants, insecticides or enzymes. Compare their uses and general production considerations.	A referenced classification and application chart.
Seminar	Explain the industrial significance of one enzyme or microbial-cell product and outline its production stages at a conceptual level.	A 5–7 minute presentation with a process diagram and references.
Quiz	Match products with applications, distinguish biomass and enzyme products, and solve basic cost and revenue questions using supplied data.	A 20-mark quiz with conceptual and numerical items.
Project	Use instructor-provided figures to estimate fixed costs, variable costs, unit cost and break-even output for a fictional fermentation product.	A spreadsheet or calculation sheet with assumptions and a sensitivity comparison.
Peer teaching	Explain fermentation economics through a worked example showing how changes in output or input cost affect unit cost.	A 5-minute lesson, worked example and short peer exercise.

Evaluation

The instructor shall prepare a dedicated rubric for each selected activity before implementation, adapting the activity-specific criteria in Section VI to the task. Share the rubric and maximum marks with students, assess the submitted evidence and individual contribution, and record feedback and marks.

Unit 3 Biofertilisers and Mushrooms

Teaching hours: 9 | Related course outcomes: CO3

3.1 Mushroom cultivation – cultivation of Agaricus campestris, Calocybe indica, Agaricus bisporus and Volvariella volvacea; preparation of compost, filling tray beds, spawning, maintaining optimal temperature, casing, watering, harvesting and storage, as applicable to the species.

3.2 Biofertilisers – chemical fertilisers versus biofertilisers; organic farming. Production of biofertilisers – Rhizobium spp., Azospirillum spp. and Azotobacter spp.

3.3 Microbial consortia for composting and as biofertilisers.

Suggested Learning Activities

Activity	Task	Expected submission
Assignment	Compare the four listed mushrooms by cultivation requirements and production stages. Prepare a separate chart on the roles of the listed biofertilisers.	Two referenced comparison charts.
Seminar	Discuss biofertilisers in organic farming or the role of microbial consortia in composting, including practical advantages and limitations.	A 5–7 minute presentation and responses to questions.
Quiz	Match biofertiliser groups with their roles and identify stages, handling considerations and quality issues in mushroom production.	A 20-mark individual quiz.
Project	Study a mushroom or biofertiliser production unit through an approved visit or documented case study. Record workflow, inputs, quality checks and marketing.	A structured observation report, process chart and reflective summary.
Peer teaching	Explain species-appropriate mushroom production stages or the purpose of microbial consortia through a diagram-based lesson.	A 5-minute lesson, labelled diagram and three check questions.

Evaluation

The instructor shall prepare a dedicated rubric for each selected activity before implementation, adapting the activity-specific criteria in Section VI to the task. Share the rubric and maximum marks with students, assess the submitted evidence and individual contribution, and record feedback and marks.

Unit 4 Baking and Brewing Processes

Teaching hours: 9 | Related course outcomes: CO1 and CO4

4.1 Brewing – medium components, preparation of medium, microorganisms involved, maturation, carbonation, packaging, keeping quality, contamination and by-products.

4.2 Bread making – yeast activation and the baking process.

4.3 Major industries in Andhra Pradesh related to microbiology.

Suggested Learning Activities

Activity	Task	Expected submission
Assignment	Compare baking and brewing by substrates, role of microorganisms, major processing stages, final products and quality considerations.	A comparison chart with annotated process flowcharts.
Seminar	Discuss maturation, carbonation, packaging and keeping quality in brewing, or explain the role of yeast in bread making.	A 5–7 minute presentation with a process diagram and references.
Quiz	Sequence major baking and brewing stages and identify contamination or quality problems from instructor-provided scenarios.	A 20-mark individual quiz.
Project	Prepare a profile of an Andhra Pradesh industry related to microbiology using an approved visit, interview or current official company sources.	An industry profile covering products, process overview, quality checks and by-product use.
Peer teaching	Explain the role of yeast in bread making using a classroom model, or teach quality checkpoints in a brewing flowchart.	A 5-minute lesson and three scenario-based check questions.

Evaluation

The instructor shall prepare a dedicated rubric for each selected activity before implementation, adapting the activity-specific criteria in Section VI to the task. Share the rubric and maximum marks with students, assess the submitted evidence and individual contribution, and record feedback and marks.

Unit 5 Detailed Project Reports and Patents

Teaching hours: 9 | Related course outcomes: CO1, CO2 and CO5

5.1 Preparation of a Detailed Project Report (DPR).

5.2 Intellectual Property Rights – trademarks, copyrights, history of patenting, composition, subject matter and characteristics of a patent, inventor, infringement and patent costs.

Suggested Learning Activities

Activity	Task	Expected submission
Assignment	Compare patents, trademarks and copyright by what they protect. Identify the main sections of a published patent using official sources.	A comparison table and an annotated patent-section outline.
Seminar	Present the purpose and structure of a DPR, or explain patent concepts through a microbiology-related published patent.	A 5–7 minute presentation with documented sources.
Quiz	Identify DPR sections and distinguish intellectual-property categories, inventor roles and basic infringement concepts in fictional scenarios.	A 20-mark individual quiz.

Activity	Task	Expected submission
Project	Prepare a sample DPR for a mushroom, biofertiliser or other microbiology enterprise. Include market need, technical plan, costs, financing, risks and implementation schedule.	A structured DPR with financial tables, assumptions and a brief intellectual-property review.
Peer teaching	Review a peer's draft DPR against a checklist, or explain the distinction between patents, trademarks and copyright using examples.	A 5-minute session, completed review checklist and constructive feedback.

Evaluation

The instructor shall prepare a dedicated rubric for each selected activity before implementation, adapting the activity-specific criteria in Section VI to the task. Share the rubric and maximum marks with students, assess the submitted evidence and individual contribution, and record feedback and marks.

III Skill Outcomes

By the completion of the course, the learner should be able to:

SO1. Prepare microbial consortia for composting.

SO2. Prepare a report on the working of a mushroom or biofertiliser production unit.

SO3. Prepare a sample Detailed Project Report.

IV Applied Microbiology Practical

Semester V | Course 6 | Credits: 1

1. Preparation of microbial consortia for composting.

2. Field visit and report preparation on a mushroom cultivation unit, biofertiliser production centre or another relevant production unit.

3. Preparation of a sample Detailed Project Report.

The instructor shall assess practical work through observation, records and an individual explanation. For consortium preparation, assess planning, execution, observations and laboratory practice. For the field report, assess observation quality, process understanding, evidence and reflection. For the DPR, assess technical feasibility, financial consistency, risk analysis and presentation. Prepare and share a dedicated rubric for each practical task.

V Co-curricular Activities

1. Prepare fermented foods.

2. Conduct a workshop on project-report preparation for a mushroom cultivation unit.

3. Visit an industry producing microbial products.

VI Evaluation of Learning Activities

The instructor is required to prepare a dedicated assessment rubric for each activity assigned. The templates below are proposed for use and adaptation; they do not prescribe institutional internal-assessment weightage. For each task, specify the unit, course outcome, expected

evidence, deadline, criteria, performance descriptors and maximum marks before the activity begins.

V SEMESTER

COURSE 6 : APPLIED MICROBIOLOGY (Practical)

credits -1

1. Preparation of Microbial consortia for composting

2. Field visit and report preparation of Mushroom cultivation unit/ Biofertiliser production centre/or any other

3. Preparation of sample DPR

References:

1. Entrepreneurial Development in India -ByArora.

2. Sathyanarayana.U, Biotechnology.(2005)1stEd.BooksandAllied(P)Ltd.

3. Casida,LEJR,(2019). Industrial Microbiology.NewAge International Publishers

4. K.R.Aneja,ExperimentsinMicrobiology,Plantpathology,Tissuecultureand Mushroom productiontechnology,6thEd. SChandPublication

5. NdukaOka for Modern Industrial Microbiology and Biotechnology. 2007. CRCPress

6. MichaelJ.Waites,NeilL.Morgan,JohnS.Rockey,GaryHigton. Industrial Microbiol ogy: AnIntroduction.2013.Wiley Blackwell Publishers.

7. A.H.Patel. Industrial Microbiology.2016. 2ndEd. Laxmi Publications, NewDelhi.

8. DubeyRC. ATextbook of Biotechnology.(2014). SChand Publishers.

9. RobertD .Hisrich,MichaelP.Peters,"Entrepreneurship Development",TataMcGr a w Hill

II. Co-Curricular Activities:

1. Prepare fermented foods

2. Workshop on project report preparation of mushroom cultivation unit

3. Visit to industry producing microbial products