

JSS MAHAVIDYAPEETA
JSS COLLEGE OF ARTS, COMMERCE AND SCIENCE
(An autonomous College of University of Mysore, Re-accredited by NAAC with 'A' grade)
B.N. Road, Mysuru-570 025, Karnataka



**CAREER ORIENTED COURSE
IN
INDUSTRIAL MICROBIOLOGY**

INDUSTRIAL MICROBIOLOGY SYLLABUS

(W.E.F. 2021)

Proposed regulations for the Career Oriented Course in Industrial Microbiology

Rule - 1 : A candidate for admission to the career oriented (Add on course) must have passed PUC (10+2) or equivalent examination with science subjects. The rules/regulations for admission for the course shall be in accordance with those framed by the college from time to time.

Rule - 2 : The course of study for the career oriented course is an add on course. Any graduate studying student with science subjects may be admitted.

Rule - 3 : The course of study is taught in three years under semester scheme. The first year course is entitled “**CERTIFICATE COURSE IN INDUSTRIAL MICROBIOLOGY**”. It shall be of one academic year with two semesters / terms of 16 weeks each.

The second year course is entitled “**DIPLOMA COURSE IN INDUSTRIAL MICROBIOLOGY**”. It shall be of one academic year with two semesters / terms of 16 weeks each. However, to join this course the candidate should have completed the Certificate Course.

The third year course is entitled “**ADVANCED DIPLOMA IN INDUSTRIAL MICROBIOLOGY**”. It shall be of one academic year with two semesters/terms of 16 weeks each. However, to join this course the candidate should have completed the Diploma Course.

Rule - 4 : In the sixth semester the candidate should undertake a project work / Industrial training.

Rule - 5 : A candidate is awarded with the respective certificates at the end of each course with the marks obtained.

Rule - 6 : A candidate will be permitted to appear for the examination provided he / she has attended both the semesters for each said course and has a minimum attendance of 75%, as

per rules.

Rule -7 : For the purpose of awarding the certificate the theory component and practical component is 70 + 30 marks respectively. In each semester under theory paper 50 marks for the actual examination and 20 marks for the Internal assessment. For the purpose of IA for theory, the college will conduct at least one test in each term. Out of 30 marks in the practical component 20 marks for the actual practical examination 05 marks for record and 05 marks for I.A. Internal Assessment for practicals should be based on performance of the experiments in each class. The experiments conducted by the candidate and results obtained should be taken into consideration. At the end of semester the concerned teacher shall take the average of marks awarded in each practical and submit it to the HOD / Course Co-ordinator.

Rule -8 : The VI Semester shall comprise exclusively a project work / industrial training to be performed by the candidate and it will be evaluated at the end for 100 marks.

J.S.S COLLEGE OF ARTS, COMMERCE AND SCIENCE, OOTY ROAD, MYSORE-25
(Autonomous)

Scheme of Study and Examination for the Career Oriented Course in Industrial Microbiology
(Add on course)

FIRST YEAR : Certificate Course in Industrial Microbiology

SEM	Paper	Title of the paper	Teaching hours per weeks		Marks for examination Maximum 100 marks				
Scheme			Theory	Practical	Theory max. 70		Practical max. 30		
					Ex.	IA	Ex.	IA	REC
I Paper code	1 IMA010	Tools and techniques in Industrial Microbiology	02	02	50	20	20	05	05
II Paper code	2 IMB010	Microbial Physiology and Genetics	02	02	50	20	20	05	05

SECOND YEAR : Diploma Course in Industrial Microbiology

SEM	Paper	Title of the paper	Teaching hours per weeks		Marks for examination Maximum 100 marks				
Scheme			Theory	Practical	Theory max. 70		Practical max. 30		
					Ex.	IA	Ex.	IA	REC
III Paper code	3 IMC010	Fermentation technology	02	02	50	20	20	05	05
IV Paper code	4 IMD010	Environmental Microbiology	02	02	50	20	20	05	05

THIRD YEAR: Advanced Diploma Course in Industrial Microbiology

SEM	Paper	Title of the paper	Teaching hours per weeks		Marks for examination Maximum 100 marks				
Scheme			Theory	Practical	Theory max. 70		Practical max. 30		
					Ex.	IA	Ex.	IA	REC
V Paper code	5 IME010	Gene Technology and Patents	02	02	50	20	20	05	05
VI Paper code	6 IMF010	Industrial Training / Project	NIL	NIL	Max.Marks 100		Report: 60 20 : Presentation 20 : viva-voce		

Total: 200 + 200 + 200 = 600 Marks

I. CERTIFICATE COURSE IN INDUSTRIAL MICROBIOLOGY

I SEMESTER

PAPER - I: TOOLS AND TECHNIQUES IN INDUSTRIAL MICROBIOLOGY

Paper code: IMA010

THEORY

28 Hours

Unit –I

7Hours

1. General introduction, Scope of industrial microbiology. History and development of industrial microbiology. Experiments of Louis Pasteur, Robert Koch and Alexander Fleming.
2. Isolation, identification and characteristics of microbes of industrial importance. Classification of bacteria, fungi, actinomycetes and viruses.

Unit –II

7Hours

3. Microscopy - Construction and working principles of bright field, phase contrast, Fluorescent microscope. A brief account on Electron Microscopy
4. Principles of sterilization: Sterilization equipments, sterilization of media, air and other ancillary equipments.

Unit –III

7Hours

5. Substrates for industrial fermentation- Raw materials, Energy sources, Mineral sources, Antifoam agents and Media formulations.
6. Batch and Continuous Fermentations, Surface, Submerged and Solid-substrate fermentations, Scale-up of Fermentation.

Unit –IV

7Hours

7. **Strain development** : Isolation, screening techniques, improvement of strains by mutation; recombination, gene regulation, technology and other genetic methods.
8. Preservation and maintenance of industrial microorganisms.

Total Marks 70: 60(Theory + 10 (Internal Assesment-Test))

**I SEMESTER
PRACTICAL: I
PAPER - I: TOOLS AND TECHNIQUES IN INDUSTRIAL MICROBIOLOGY
10 Practicals(1 Practical of 2 hours per week)**

1. Laboratory safety : Good laboratory practices.
2. Study of simple and compound microscopes, their handling, including oil immersion objective.
3. Demonstration of laboratory equipments: Pressure cooker, Autoclave, Hot-air oven, Incubator, Inoculation chamber / Inoculation hood, Inoculation loop, Inoculation needle, Membrane filter and Colony counter.
4. Demonstration of pH meter, Colorimeter, Absorption and emission spectroscopy and Turbidometer.
5. Preparation of media: Nutrient agar and Potato Dextrose Agar.
6. Cultivation of microorganisms on agar plate (point inoculation), broth, anaerobic cultivation (candle jar / gas pack method).
7. Isolation of microorganisms by spread plate, pour plate and streak plate methods.
8. Maintenance of stock culture on fresh agar slants; overlaying with mineral oil and stab culture.
9. Staining and mounting of algae (*Chlorella*) and fungi (*Pencillium*).
10. Staining of bacteria (simple and differential staining).

Total Marks 30:20 (Practicals)+05 (Internal Assesment-Test)+05(Record)

II SEMESTER

PAPER - II: MICROBIAL PHYSIOLOGY AND GENETICS

Paper code: IMB010

THEORY

28hours

Unit-I

7Hours

1. **Microbial cell structure and function**-prokaryotes, eubacteria and fungi with reference to their cell membrane, cell wall and internal cellular organization.
2. **Microbial nutrition**: Nutritional requirements of microorganisms – uptake of nutrients- active transport, passive transport, facilitate diffusion, group translocation and iron uptake.

Unit-II

7Hours

3. Microbial growth and generation time, growth curve-phases of growth and their significance. Measurement of growth by cell number and biomass; direct microscopic count (Haemocytometer, turbidometer and spectrophotometer method).
4. **Microbial Metabolism**: Photosynthetic microbes, oxygenic and non-oxygenic photosynthesis, photophosphorylation, Calvin cycle dark reaction. Respiratory pathways - Glycolysis, Kreb's cycle, pentose phosphate pathway, oxidative and substrate level phosphorylation.

Unit-III

7Hours

5. Chromosomes-prokaryotic and Eukaryotic organization. Cell division-mitosis, meiosis and cell cycle regulation. Recombination in bacteria; Transformation, Transduction (types) and Conjugation process, F-factor, Transposons, Extrachromosomal genetic elements and their importance.

Unit-IV

7Hours

6. Chemical basis of heredity-evidence for DNA and RNA as genetic material. Watson and Crick model of DNA, structure and its functional importance. DNA replication- mode and mechanism of Replication in prokaryotes and eukaryotes.

Total Marks 70:20(Theory)+10(Internal Assesment-Test)

**II SEMESTER
PRACTICAL:II
PAPER - II : MICROBIAL PHYSIOLOGY AND GENETICS
10 Practicals(1 Practical of 2 hours per week)**

1. Acid and gas production from Carbohydrates - demonstration of fermentation of Lactose.
2. Starch hydrolysis.
- 3-5. Qualitative tests for the detection of macromolecules.
 - Glucose - Benedict's test, Molisch's test, Fehlings test, Picric acid test.
 - Protein - Biurette test, Ninhydrin test, Millon's test, Xanthoproteic test.
 - Lipids - Acrolein test, Sudan III test, Emulsification test and Solubility test.
6. Effect of temperature on growth of microorganisms.
7. Effect of pH on growth of microorganisms.
8. Measurement of growth by cell number using Haemocytometer and cell mass by turbidometer/ spectrophotometer method.
9. Isolation of DNA.
10. Demonstration of the following models / photographs of DNA, Transcription and Translation, DNA replication, t-RNA.

Total Marks 30: 20(Practicals)+05 (Internal Assesment-Test)+05(Record)

DIPLOMA COURSE IN INDUSTRIAL MICROBIOLOGY

III SEMESTER

PAPER-III : FERMENTATION TECHNOLOGY

Paper code: IMC010

THEORY

28hours

Unit-I

7Hours

1. **Introduction to Fermentations:** Design of typical fermenters, devices for aeration and agitation, Seed and Pilot Scale fermenters.
2. **Down Stream Processing :** Recovery of fermentation products-precipitation, filtration, centrifugation, distillation, cell disruption, solvent recovery, drying and crystallization.

Unit-II

7Hours

3. **Industrial production and their uses :**
Enzymes : Amylase
Vitamins - Vitamin B-12
Antibiotics: Penicillin.
SCP : *Spirulina*
Organic acids : Citric acid.
Production of fuels : Ethanol
Health care products : Steroid transformation, Monoclonal antibodies.

Unit-III

7Hours

4. **Food fermentations :** Alcoholic beverages, Cheese making, Bread making, Fermented soya based foods. Meat fermentation, Fermented milk and mushroom cultivation.

Unit-III

7Hours

5. **Microbes-Plant interaction-** Mycorrhizae-Biology and applications, **Biofertilizers**, microbial inoculants, Brief account of production and application of *Rhizobium*, *Azotobacter*, *phosphobacteria* and *Cyanobacteria*.
Biopesticides : Fungal, Bacterial and Viral Biopesticides and their applications.

Total Marks 70:60(Theory)+10(Internal Assesment-Test)

**III SEMESTER
PRACTICAL: III
PAPER-III: FERMENTATION TECHNOLOGY
10 Practicals (1 Practical of 2 hours per week)**

1. Isolation and identification of microorganisms of spoiled fruits (fungi and bacteria).
2. Isolation of *Aspergillus flavus* from spoiled food.
3. MBRT test for microbial contamination of milk.
4. Isolation of *Lactobacilli* and *Streptococcus* from curds.
5. Production of citric acid from *Aspergillus niger*.
6. Production of wine from grapes.
7. Production of alcohol from jaggery / Molasses.
8. Estimation of Percentage alcohol in a given sample by specific gravity bottle method.
9. Mushroom cultivation.
10. Antibiotic sensitivity test.

Total Marks 30:20(Practicals)+05 (Internal Assesment-Test)+05(Record)

IV SEMESTER		
PAPER - IV: ENVIRONMENTAL MICROBIOLOGY		
Paper code: IMD010	THEORY	28hours
	Unit-I	7Hours
1.	Marine and freshwater microorganisms. The microbial community in marine and freshwater environments. Water purification, Microbiological analysis of water. Waste water and effluent treatment - treatment methods – Primary, Secondary and tertiary treatment. Sludge treatment and disposal, Composting and Ensiling.	
	Unit-II	7Hours
2.	Nutrient cycling processes: Biogeochemical cycles: Nitrogen cycle, Phosphorous cycle and Carbon cycle.	
3.	The environments of soil microorganisms: Associated soil microorganisms with plants. Microbial interaction: Neutralism, Mutualism, Parasitism, Antagonism, Comensalism, Predation, Synergism, and competition. Rhizosphere, Actinorrhizae and Mycorrhizae.	
	Unit-III	7Hours
4.	Aerobiology : Air-borne microbes, Sampling techniques-Andersen sampler, Rotorod sampler, Hirst spore trap and Vertical cylinder spore trap. Aerobiology and Human health.	
5.	Microbes and degradation of wastes: Treatment of solid and liquid industrial wastes, Microbial degradation of pesticides and Xenobiotics, Bioremediation.	
	Unit-IV	7Hours
6.	GeoMicrobiology: Microbes in metal extraction, Mineral leaching and mining.	
7.	Production of biopesticides (microbial insecticides) <ul style="list-style-type: none"> - Bacterial, Viral, Fungal and protozoa. - Production of microbial herbicides. 	
Total Marks 70: 60(Theory)+10(Internal Assesment-Test)		

**IV SEMESTER
PRACTICAL:IV
PAPER - IV: ENVIRONMENTAL MICROBIOLOGY
10 Practicals(1 Practical of 2 hours per week)**

1. Microscopic observations of different water samples for biological indicator of water pollution.
2. a) Standard analysis of water.
b) Determination of MPN.
3. IMViC tests.
4. Viable count – SPC and Membrane Filter Technique.
5. Determination of BOD
6. Estimation of total solids in sewage.
7. Measurement Cl_2 , PO_4 and NO_3 in water.
8. Demonstration of - Production of Vermicompost.
9. Isolation of free-living N_2 fixers from soil.
10. Visit to Effluent treatment plant.

Total Marks 30: 20 (Practicals) + 05 (Internal Assesment-Test) + 05(Record)

**ADVANCED DIPLOMA COURSE IN INDUSTRIAL MICROBIOLOGY
V SEMESTER
PAPER - V: GENE TECHNOLOGY AND PATENTS**

Paper code: IME010	THEORY	28Hours
	Unit-I	7 hours
1.	Genetic Engineering: Definition, concept and scope of genetic engineering; Milestones in Recombinant DNA Technology. Gene technology and industrial microbiology.	
2.	Recombinant DNA Technology: Restriction enzymes; Isolating and cloning fragments; Isolating and purifying cloned DNA, Genomic and C-DNA Libraries and Cloning vectors.	
	Unit-II	7 hours
3.	Selection of recombinants: Expression of foreign genes in cloned organisms.	
4.	Analysis of gene products : (a) Nucleic acid hybridization, (b) Sequencing of proteins, and nucleic acids, Southern, Northern and Western blotting techniques, PCR and DNA finger printing.	
	Unit-III	7 hours
5.	Genetic engineering : Safety, Social, Legal and Ethical considerations. Risk in genetic engineering. Microbial transformation: Types of bioconversion reactions, procedure for biotransformation and transformation of antibiotics.	
6.	Applications of genetic engineering : a) Medical, b) Industrial, c) Environmental and d) Agricultural Applications – in brief	
	Unit-IV	7 hours
7.	Patents; patent regulations of processes, products and microorganisms, Entrepreneurship and marketing of products.	

Total Marks 70: 60(Theory) + 10(Internal Assesment-Test)

**V SEMESTER
PRACTICAL: V
PAPER - V: GENE TECHNOLOGY AND PATENTS
10 Practicals(1 Practical of 2 hours per week)**

1. Isolation of genomic DNA and its quantification.
2. Isolation of RNA and its quantification.
3. Salt fractionation of yeast proteins and quantification.
4. Separation of proteins by SDS-PAGE.
5. Isolation of Streptomycin resistant mutant of *E. coli*.
6. Isolation of plasmid from bacteria purification by agarose gel electrophoresis.
7. Preparation of competent *E. coli* cells.
8. Transformation and recovery of plasmid clones.
9. Demonstration of Southern blotting and Northern blotting.
10. Demonstration of PCR Technology.

Total Marks 30: 20(Practicals) + 05 (Internal Assesment-Test) + 05(Record)

Paper code: IMF010

VI SEMESTER

PAPER-VI: INDUSTRIAL TRAINING / PROJECT WORK

The candidate need to work for a period of 16 weeks in any recognized Industry / University, under the guidance of an expert in the field of Industrial Microbiology. At the end of the semester candidate need to submit a report duly certified by the authority of the industry / Academic institution. The same should be certified by the HOD / Co-ordinator. The project work will be evaluated for 100 marks (60 for report and 20 for presentation and 20 for Viva-Voce examination)

Signature of the Co-Ordinator
Microbiology

**SCHEME OF THEORY EXAMINATION FOR UGC CAREER ORIENTED
COURSE IN INDUSTRIAL MICROBIOLOGY**

(Applicable to Semester I to V)

Time: 03 Hrs

Max. Marks: 50

1. Answer any TEN of the following : 1 x 10 =10
(12 questions to be given and 10 to be answered)
 - a)
 - b)
 - c)
 - d)
 - e)
 - f)
 - g)
 - h)
 - i)
 - j)
 - k)
 - l)

2. Answer any FOUR of the following 4 x 4 = 16
(6 questions to be given and 4 to be answered) – short answer type
 - a)
 - b)
 - c)
 - d)
 - e)
 - f)

3. (3, 4, 5 essay type questions – Each with internal choices) 8x 3 = 24

**SCHEME OF PRACTICAL EXAMINATION FOR CAREER ORIENTED COURSE IN
INDUSTRIAL MICROBIOLOGY**

(Applicable to Semester I, II, III, IV and V)

Time : 03 Hrs

Max. marks : 25(20 + 05)

- | | |
|--|--------------|
| 1. Conduct experiment 'A' assigned, tabulated data, analyse and draw conclusions | 08 |
| 2. Write a critical notes on B, C and D. | (3 x 2) = 06 |
| 3. Identify E, F and G with reasons. | (3 x 2) = 06 |
| 4. Class Record | 05 |

Internal assessment-05

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List of Examiners Recommended by the BOS in Microbiology

Sl No.	Name	College address
1	Dr..M .Seema	Chairperson, Dept. of Microbiology JSS College, Ooty road, Mysore
2	H.P.Spoorthy	Assistant prof. Dept. of Microbiology JSS College, Ooty road, Mysore
3	Dr.S.Mahadevamurthy	Associate Prof & HOD Dept. of Microbiology Yuvaraja's college Mysore.
4	Dr.Syeda Kauser Fathima	Associate Prof. of Microbiology Maharani's Science College for women JLB road Mysore.
5	Dr. H.S. Jayanth.	Asso.Prof.of Microbiology Dept. of Microbiology Yuvaraja's college Mysore.
6	Dr.Uma Maheshwari	Assistant prof. JSS University, JSSAHER, Mysuru
7	Sri. M. Girish	Assistant prof. Dept. of Microbiology JSS College for Women Saraswathipuram,Mysore
8	Dr. P.K.Maheshwar	Assistant Prof. Dept. of Microbiology Yuvaraja's college,Mysore.
9	Smt. M.S.Shobha	Assistant Prof, Dept. of Microbiology Maharani's Science College Mysore
10	Sri. R.A. Manjunath	Assistant Prof. Dept. of Microbiology Saradavilas College,Mysore
11	Dr.M.P. Ragavendra	Assistant Prof. Dept. of Microbiology Maharani's Science College,Mysore

12	Dr.K.Girish	Assistant Prof. Dept. of Microbiology Maharani's Science College, Mysore
13	Sri. G.S. Siddegowda	Assistant Prof. Dept. of Microbiology Maharani's Science College Mysore
14	Dr.N.S.Devaki	Assistant Prof. Dept. of Molecular Biology Yuvaraja's College , Mysore
15	Syeda Farahna Parveen	Assistant Prof. Dept. of Microbiology St.Philomina's College, Mysore
16	Smt. Vanitha	Assistant Prof. Dept. of Microbiology Maharani's Science College,Mysore
17	Smt. Revanamba	Assistant Prof. Dept. of Microbiology Maharani's Science College,Mysore
18	Mahadevaprasad	Assistant prof. Dept. of Microbiology JSS College for Women Saraswathipuram,Mysore
19	Dr.Nagalambika	Assistant prof. JSS University, JSSAHER, Mysuru
20	RajaRajeshwari.R	Assistant prof. Dept. of Microbiology SDM College JLB Road,Mysuru
21	Uzma Bathool	Assistant Prof. Dept. of Microbiology St.Philomina's College, Mysore
22	Shruthi Prakash	Assistant Prof. Dept. of Microbiology Mahajana's Science College,Mysuru
23	Athiya sultan	Assistant prof. Dept. of Microbiology SDM College JLB Road,Mysuru
24	C.Poornima Devi	Assistant Prof. Dept. of Microbiology Yuvaraja's college,Mysore

25	Dr.Rakshith	Assistant Prof. Dept. of Microbiology Yuvaraja's college,Mysore
26	Vasundara Devi R	Assistant Prof. Dept. of Microbiology Maharani's Science College,Mysore
27	Niveditha Prakash	Assistant prof. Dept. of Microbiology JSS College for Women Saraswathipuram,Mysore
28	Dr.K.Sumana	Assistant prof. JSS University, JSSAHER ,Mysuru
29	Samjna.S.R	Assistant Prof. Dept. of Microbiology Maharani's Science College,Mysore

DEPARTMENT OF MICROBIOLOGY

LIST OF BOS MEMBERS (2020-23)

	MEMBERS	SIGNATURE
1	Dr. M. Seema-Chairperson Assistant Professor and Head Department of Microbiology JSS College, Ooty road, Mysuru-25	
2	Dr. Shubha Gopal Professor DOS in Microbiology Manasagangotri, Mysuru Member (VC Nominee)	
3	Dr.C. R. Rekha Associate Professor DOS in Microbiology Government Science First Grade College Yelahanka Bengaluru Member (VC Nominee)	
4	Dr. Syeda Kousar Fathima Associate Professor PG Department of Microbiology Maharani's Science College, Mysuru Member (VC Nominee)	
5	Dr. Srilakshmi Desiraju TRIPHASE Pharmaceuticals pvt. Ltd KSSIDC, Hebbal Industrial area , Mysuru	
6	Chethana. G Jnanasarovara International Residential School Vajamangala post, Bannur road Mysuru-11	

