

Syllabus and Course Scheme  
Academic year 2024-25



*B.Sc.- Microbiology  
Exam.-2025*

**UNIVERSITY OF KOTA**

***MBS Marg, Swami Vivekanand Nagar, Kota -  
324 005, Rajasthan, India***

***Website: uok.ac.in***

### B.Sc. Microbiology Pt-III Examination

	Lec Hrs/week	Exam hrs.	Max Marks
<b>Core paper (Theory)</b>			
BMB – 19 Biosafety & IPR	3	3	50
BMB – 20 Soil and Agriculture Microbiology	3	3	50
BMB – 21 Tools and Techniques in Microbiology	3	3	50
BMB – 22 Computer Applications & Biostatistics	3	3	50
BMB – 23 Biophysics and Instrumentation	3	3	50
BMB – 24 Industrial Microbiology	3	3	50
<b>Total of Theory Papers</b>			<b>300</b>
<b>Core Paper (Practicals)</b>			
BMB –25 Biosafety & IPR + Soil and Agriculture Microbiology		3	50
BMB –26 Tools and Techniques in Microbiology+ Computer Applications and Biostatistics		3	50
BMB –27 Biophysics and Instrumentation+ Industrial Microbiology		3	50
<b>Total of Practical Papers</b>			<b>150</b>
<b>Grand Total (Theory+ Practical)</b>			<b>450</b>

The marks secured in the Compulsory paper of Environmental Studies shall not be counted in awarding the division to a candidate.

Maximum of three chances will be given to a candidate to pass compulsory paper.

Non appearing or absent in the Examination of compulsory paper will be counted a chance.

A candidate shall be eligible to appear in supplementary examination in maximum of two Core theory papers as per University Rules.

One percent of the maximum marks may be awarded as Grace Marks to the candidates in accordance to the University Rules as applicable to all other Under Graduate examinations. Minimum requirement of lectures completing each core theory and compulsory paper shall be 78 hours, and for each practical 156 hours.

## MICROBIOLOGY PRACTICALS – (I, II, III)

### *Distribution of Marks*

**Min. pass marks: 18**

**Duration: 3 hours  
REGULAR**

**Max. Marks: 50  
EX-STUDENT**

1. Major Exercise	12	12
2. Minor Exercise	10	10
3. Preparation	8	8
4. Spots (5)	10	10
5. Record	5	-
6. Viva-voce	5	10
<b>TOTAL</b>	<b>50</b>	<b>50</b>

### B.Sc. Microbiology Pt-III Examination

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<b>Core paper (Theory)</b>			
BMB – 19 Biosafety & IPR	3	3	50
BMB – 20 Soil and Agriculture Microbiology	3	3	50
BMB – 21 Tools and Techniques in Microbiology	3	3	50
BMB – 22 Computer Applications & Biostatistics	3	3	50
BMB – 23 Biophysics and Instrumentation	3	3	50
BMB – 24 Industrial Microbiology	3	3	50
<b>Total of Theory Papers</b>			<b>300</b>
<b>Core Paper (Practicals)</b>			
BMB –25 Biosafety & IPR + Soil and Agriculture Microbiology		3	50
BMB –26 Tools and Techniques in Microbiology+ Computer Applications and Biostatistics		3	50
BMB –27 Biophysics and Instrumentation+ Industrial Microbiology		3	50

<b>Total of Practical Papers</b>	<b>150</b>
<b>Grand Total (Theory+ Practicals)</b>	<b>450</b>

## **BMB-19 Biosafety And Intellectual Property Rights (IPR)**

Duration :3 hrs

Max .Marks50

Note - The paper is divided into five units. Two questions will be set from each unit. The candidates are required to attempt one question from each unit. All questions carry equal marks.

### **Unit I**

Biosafety: Introduction; biosafety issues in biotechnology; Biological Safety Cabinets & their types; Primary Containment for Biohazards; Biosafety Levels of Specific Microorganisms.

### **Unit II**

Biosafety Guidelines: Biosafety guidelines and regulations (National and International); GMOs/LMOs- Concerns and Challenges; Role of Institutional Biosafety Committees (IBSC), RCGM, GEAC etc. for GMO applications in food and agriculture; Environmental release of GMOs; Risk Analysis; Risk Assessment; Risk management and communication;

### **Unit III**

Introduction to Intellectual Property: Patents, Types, Trademarks, Copyright & Related Rights, Industrial Design and Rights, Traditional Knowledge, Geographical Indications- importance of IPR – patentable and non patentables – patenting life – legal protection of biotechnological inventions – World Intellectual Property Rights Organization (WIPO).

### **Unit IV**

Grant of Patent and Patenting Authorities: Types of patent applications: Ordinary, PCT, Conventional, Divisional and Patent of Addition; An introduction to Patent Filing Procedures; Patent licensing and agreement; Patent infringement- meaning, scope, litigation, case studies, Rights and Duties of patent owner.

### **Unit V**

Agreements and Treaties: GATT, TRIPS Agreements; Role of Madrid Agreement; Hague Agreement; WIPO Treaties; Budapest Treaty on international recognition of the deposit of microorganisms; UPOV & Brene conventions; Patent Co-operation Treaty (PCT); Indian Patent Act 1970 & recent amendments.

## References:

1. Bare Act, 2007. Indian Patent Act 1970 Acts & Rules, Universal Law Publishing Co. Pvt. Ltd., New Delhi.
2. Kankanala C (2007). Genetic Patent Law & Strategy, 1st Edition, Manupatra Information Solution Pvt. Ltd. New Delhi.
3. Mittal, D.P. (1999). Indian Patents Law, Taxmann, Allied Services (p) Ltd.
4. Singh K K (2015). Biotechnology and Intellectual Property Rights: Legal and Social Implications, Springer India.
5. Goel D & Prashar S (2013). IPR, Biosafety and Bioethics. Pearson.
6. Senthil Kumar Sadhasivam and Mohammed Jaabir, M. S. 2008. IPR, Biosafety and biotechnology Management. Jasen Publications, Tiruchirappalli, India.

## **BMB-20-Soil and Agriculture Microbiology**

Duration :3 hrs

Max .Marks50

Note - The paper is divided into five units. Two questions will be set from each unit. The candidates are required to attempt one question from each unit. All questions carry equal marks.

### **UNIT-I**

Soil: definition, classification, types, physical and chemical properties, soil as a natural habitat for microorganisms. Soil microflora, Lithification. Decomposition of organic matter by microorganisms - cellulose, hemicelluloses chitin lignin and pectin. Importance and function of soil and soil microorganisms, factors influencing the microbial communities in soil.

### **UNIT -II**

Biological nitrogen fixation (BNF): Nitrification, denitrification; symbiotic nitrogen fixation (Rhizobium, Frankia), non-symbiotic nitrogen fixation (Azotobacter, Azospirillum); Nitrogenase enzyme, nif genes and molecular mechanism of nitrogen fixation. Genetic engineering of BNF.

### **UNIT -III**

Biopesticides-introduction, types, mode of action and factors influencing, target pests. Biological control: Introduction, mechanism of antagonism, amensalism, competition, predation and parasitism (mycoparasitism, nematophage, mycophagy), application of biological control on field.

### **UNIT -IV**

Biofertilizers: Definition, types- Nitrogen fixing, Phosphate solubilizing Cultivation and mass production of bioinoculants- Azotobacter, Rhizobium, Cyanobacteria, Azolla.-Carrier-based inoculants - production and applications. PGPRs, phytoalexins, PR proteins, Transgenic approaches for crop protection.

## UNIT -V

Plant pathology: Introduction : Historical developments in brief, classification of plant diseases, principles of infection and spread of diseases in general. Soil born diseases – Damping off, root rot and vascular wiltscouse, symptoms& their control.

### References

1. P.D.Sharma.2006. Plant pathology. Alpha Science International.19.
2. Sharma.P.G. 2006. Plant Pathology. Rastogi Publication.
3. Agrios G.N. (2009), Plant Pathology. 5th Ed. Academic Press.
4. Paul E.A.2007. Soil Microbiology: Ecology and Biochemistry,3Edn. Academic Press.
5. John L. Havlin et al., 2004. Soil Fertility and Fertilizers: An Introduction to Nutrient Management (7th Edition). Prentice Hall.
6. Coyne M. 1999. Soil Microbiology Delmar Cengage Learning
7. Mehrotra, Aggarwal R, Ashok.2004. Plant Pathology. 2nd Edition Tata McGraw-Hill..
8. Rangaswami .Gand D.J. Bagyaraj. (1998) Agricultural Microbiology. 2nd Ed. PHI. India.
9. Subbarao, N.S. and Dommergues, Y.R. (1998) Microbial interactions in agriculture and forestry. Science publishers.
10. Mahendra K. Rai (2005). Hand Book of Microbial Biofertilizers, The Haworth Press, Inc. New York.
11. Atlas RM and Bartha R. (2000). Microbial Ecology: Fundamentals & Applications. 4th edition

### BMB – 21 Tools and Techniques in Microbiology

Duration :3 hrs

Max .Marks50

Note - The paper is divided into five units. Two questions will be set from each unit. The candidates are required to attempt one question from each unit. All questions carry equal marks.

#### Unit-I

Microscopy: Basic idea of light microscopy, Principle, types and applications of - bright field, dark field, fluorescence and phase-contrast microscopes. Techniques in light microscopy-wet mount, hanging drop preparations.

#### Unit-II

Electron microscope-Basic idea of structure and functioning of E.M., Preparation of material for electron microscopy, Types-TEM, SEM, Scanning probe microscope, scanning tunnel microscope, atomic force microscope.

### **Unit-III**

Principles, working and applications of- Autoclave, Laminar Airflow, Hot Air Oven, Analytical and differential pH meters.

Centrifuge: Rotors, Bench top, Low Speed, High Speed, Cooling Centrifuge, gradient centrifugation. Principles and Application of Ultracentrifugation. Principle and applications of native polyacrylamide gel electrophoresis, SDS- polyacrylamide gel electrophoresis.

### **Unit-IV**

Principles and applications of paper chromatography (including Descending and 2-D), Thin layer chromatography. Column packing and fraction collection. Gel filtration chromatography, ion exchange chromatography and affinity chromatography, GLC, HPLC. Spectrophotometer: Principle and use of study of absorption spectra of biomolecules. Analysis of biomolecules using UV and visible range. Colorimetry and turbidometry.

### **Unit-V**

Microbiological stains and Staining techniques for light microscopy: Types of stains and principles of staining. Preparation of bacterial smears for light microscopy: Fixation, Simple staining (positive and negative), differential staining (Gram's staining and acid – fast staining), structural staining (Capsule, Flagella, Cell wall and Endospore of bacteria), nuclear staining. Wet mounting method – staining of algae and fungi. Hanging drop method.

### **References:**

1. Advances in Chromatography. Eli Grushka and Nelu Grinberg (2007). Publisher: CRC: 1st edition. ISBN-10: 1420060252, ISBN-13: 978-1420060256, Volume 46.
2. Understanding NMR Spectroscopy. James Keeler (2005). Publisher: Wiley; 1st edition ISBN-10: 0470017872, ISBN-13: 978-0470017876.27
3. Physical Principles of Electron Microscopy: An Introduction to TEM, SEM, and AEM. Ray F. Egerton (2005). Publisher: Springer; 1st ed.. ISBN-10: 0387258000, ISBN-13: 978-0387258003.
4. Fundamentals of Light Microscopy and Electronic Imaging. Douglas B. Murphy (2001). Publisher: Wiley-Liss; 1st edition ISBN-10: 047125391X, ISBN-13: 978-0471253914.
5. Principles and Techniques of Practical Biochemistry. Keith Wilson & John Walker(2000). Cambridge University Press.
6. Introduction to Spectroscopy. Donald L. Pavia, Gary M. Lampman, and George S. Kriz (2000). Publisher: Brooks Cole; 3rd edition. ISBN-10: 0030319617, ISBN-13: 978-0030319617

Duration :3 hrs

Max.Marks 50

Note - The paper is divided into five units. Two questions will be set from each unit. The candidates are required to attempt one question from each unit. All questions carry equal marks.

#### **UNIT-I**

Introduction to computers – classification of computers – computer generation, software and hardware – operating systems – secondary storage media – personal, mini, main frame and super computers, their characteristics and application, BIT, BYTE, WORD, computer memory and its types; data representation and storage binary codes, binary system and its relationship to Boolean Operations.

#### **UNIT-II**

Microsoft Excel – Data Entry – graphs – aggregate functions – formula and functions. Different number systems and conversions input-output devices, Types of networking- LAN, WAN and VPN, Benefits of internet.

#### **UNIT-III**

Basic concepts in Statistics: Terms and Definitions in Statistics, Collection of Data, Types of variables: Continuous and discrete, Frequency Distribution, Classification of tabulation.

#### **UNIT-IV**

Sample and Sampling techniques.  
Measurements of central tendency: Mean, Median, Mode  
Standard Deviation, Variance, Chi- Square test.

#### **UNIT-V**

Correlation: types and methods.  
Regression analysis, multiple linear regressions.  
Standard error, Concept of Hypothesis, t-test, One way ANOVA.  
Probability: Definition and basic formula and theories.

#### **Reference:**

1. Snedecar, G.W. and Cochran WG. (1967) Statistical Methods, Oxford Press.
2. Danial, W.W. (1995) : Biostatistics : A Foundation for analysis in Health Sciences (6<sup>th</sup> Ed.) John Wiley.780pp
3. Cotton T. (1974); Statistics in Medicine, Little Brown,Boston.
4. Compbell, R.C. (1989): Statistics for Biologists, Cambridge University Press. 464pp.

### **BMB - 23 Biophysics and Instrumentation (Theory)**

**Min. passmarks:18**

**Duration: 3hours**

**Max.**

**Marks:50**

**Note:** Attempt any five questions, taking at least one question from each unit. Each question carries equal marks.

#### **UNIT-I**

Bioenergetics: Energy and its various forms, principle of Thermodynamics, energy



exchange, conservation of energy.

Photobiology: Nature of light, Primary photochemical reactions, Photosynthesis, flowering, Solarization, Photo dynamism, Strategies in light reception, Photoreceptor in microbes. Plants and animals.

#### **UNIT-II**

Biophysics of vision, vision fault and correlations, Bioluminance.

Biophysics of sound vibration, Phono-receptor, Auditory function, Location and origin of sound, Hearing aids.

Membrane conductivity, Diffusion, Active transport, Osmosis, Diffusion pressure deficit, Biosorption, Electrical properties of biological compartments, Electrochemical gradients, membrane potentials.

#### **UNIT-III**

Molecular interaction: Intra- molecular and Inter- molecular interaction, Attractive and repulsive forces operating within molecules and their overall effects on molecular interactions. Radioactivity: Nucleus. Properties. Nuclear forces. Nuclear radiations and their properties - alpha, beta and gamma. Half life, physical and biological handling and standardization of alpha and beta emitting isotopes

#### **UNIT-IV**

Radioimmunoassay. Radiopharmaceuticals and their uptake. Production of radionuclides. Radiations and their interaction with matter, Electromagnetic radiation, Raman spectra, Nuclear magnetic Resonance Measurement of radiation - Dosimetry and detectors. Radioactive tracer techniques, Autoradiography.

#### **UNIT-V**

Principle, construction and working of – GM counter. Scintillation Counter (Solid and liquid). Elucidation of intact biological structures in living organisms: Ultrasound. Optical filters, Computerized Axial Tomography, Electrocardiography, Electro- encephalography.

#### **Reference Books:**

1. Fundamentals and Techniques of Biophysics and Molecular Biology” by Pranav Kumar.
2. Biophysics: A Physiological Approach” by Patrick F Dillon.
3. Fundamental of Biophysics By , S. K. Agrawal.
4. Bioinstrumentation by Willey.

### **BMB 24- Industrial Microbiology**

Duration: 3 hrs

Max .Marks 50

Note - The paper is divided into five units. Two questions will be set from each unit. The candidates are required to attempt one question from each unit. All questions carry equal marks.

#### **UNIT-I**

Brief history and developments in industrial microbiology.

Types of fermentation processes - solid state, liquid state, batch, fed-batch and continuous.

Physicochemical standards used in fermentors /Bioreactor. Components of a typical bio-

reactor, Types of bioreactors-Laboratory, pilot- scale and production fermenters, constantly stirred tank and air-lift fermenters.

#### **UNIT-II**

Measurement and control of fermentation parameters - pH, temperature, dissolved oxygen, foaming and aeration. Primary and secondary screening of industrial strains.

Sources of industrially important microbes and methods for their isolation, preservation and maintenance of industrial strains, strain improvement, Crude and synthetic media; molasses, cornsteep liquor, sulphite waste liquor, whey, yeast extract and protein hydrolysates,

#### **UNIT-III**

Fermentation in batch culture: Microbial growth kinetics, measurement of growth (cell number direct and indirect method) Continuous culture system, Aeration, Agitation, Oxygen transfer kinetics. Sterilization.

#### **UNIT-IV**

Downstream processing: Filtration, Precipitation, cell disintegration, solvent extraction, chromatographic separation. solvent recovery, drying, crystallization.

#### **UNIT-V**

Biotransformation: Development of inoculum, Industrial production of Penicillin, ethyl alcohol, acetic acid, amylase and vitamin B<sub>12</sub>, Single cell protein.

#### **References:**

1. Crueger W and Crueger A. (2000). Biotechnology: A textbook of Industrial Microbiology. 2nd Edition. Panima Publishing Company, New Delhi.
2. Patel AH. (1996). Industrial Microbiology .1st Edition. MacMillan India Limited Publishin Company Ltd. New Delhi, India.
3. Tortora GJ, Funke BR, and Case CL. (2008). Microbiology: An introduction.9th Edition. Pearson Education.
4. Willey JM, Sherwood LM AND Woolverton CJ (2013), Prescott, Harley and Klein's Microbiology.9th Edition. McGraw Hill Higher education.
5. Casida LE. (1991). Industrial Microbiology. 1st edition. Wiley Eastern Limited.
6. Stanbury PF, Whitaker A and Hall SJ. (2006). Principles of Fermentation Technology. 2nd edition, Elsevier Science Ltd.

#### **Practicals**

**BMB –25 Biosafety & IPR + Soil and Agriculture Microbiology**

Max .Marks50

Min .Marks18

1. Study of components and design of a BSL-III laboratory.
2. Filing applications for approval from biosafety committee (IBSC).
3. Filing primary applications for patents.
4. Study of steps of a patenting process.
5. A case study.
6. Study soil profile
7. Study microflora of different types of soils.
8. Isolation and identification of fungi from soil.
9. Isolation and enumeration of bacteria from soil by serial dilution method
10. Rhizobium as soil inoculants characteristics and field application
11. Azotobacter as soil inoculants characteristics and field application
12. Design and functioning of a biogas plant
13. Isolation of cellulose degrading organisms
14. Study of VAM.
15. Study of the plant diseases: Gram staining of citrus canker specimen and mounting of fungal specimens

### **Practicals**

#### **BMB –26 Tools and Techniques in Microbiology+ Computer Applications and Biostatistics**

Max .Marks50

Min .Marks18

1. Study of organization and working of microscopes.
2. Optical Microscopes : dissecting and compound
3. Exposure to organization and working of phase contrast microscope and electron microscopes.
4. Sterilization of glassware and media (use of autoclave). Aseptic transfer.
5. Study and use of micro analytical techniques.
6. Separation of sub- cellular organelles (use of centrifuge and other techniques)
7. Separation of cell organelles by sucrose gradient.
8. Electrophoresis : SDS – PAGE
9. Thin layer chromatography
10. Paper chromatography : circular and vertical
11. Visit to microbiological laboratory for exposure of various advanced tools and techniques.
12. Creating charts in excel using different data.
13. Design a worksheet for numeric entries and perform required calculation.
14. Design a worksheet enter required data and perform aggregate function like sum, average, count etc.
15. Perform regression analysis and calculate future value.
16. Changing settings of keyboard, mouse and display.
17. Perform file operation like copy, save, rename, delete using window explore.
18. Calculate mean, mode and median
19. Calculate correlation & regression.

## Practicals

### BMB –27 Biophysics and Instrumentation+ Industrial Microbiology

Max .Marks50

Min .Marks18

1. Principles and application of instruments:

- a. pH meters (digital).
- b. Light and phase contrast microscope.
- c. Colorimeter.
- d. Spectrophotometer (Visible and UV).
- e. Sound level meter.
- f. Audiometer.
- g. GM counter and Scintillation counter
- h. Incubator
- i. Shaker
- j. Laminar flow bench
- k. Hearing aids

2. Microbial fermentation for the production and estimation of amylase.
3. Microbial fermentation for the production and estimation of citric acid.
4. Microbial fermentation for the production and estimation of ethanol.
5. Culturing of Spirulina / Chlorella.
6. Fermenter design and components.