## DEPARTMENT OF MICROBIOLOGY

## BUNDELKHAND UNIVERSITY, JHANSI

# Ordinance

**A.** There shall be a B.Sc. (H) and a M.Sc. program administered by the Department of Microbiology

**B.** The programs shall be run on full time basis.

**C.** Subject to overall control of the Academic Council, the B.Sc. and M.Sc. program will be administered by a course committee consisting of HOD (Chairman) and all the teachers of the department.
This committee shall

**1.** Invite, scrutinize applications and make admissions to the B.Sc. (H) and M.Sc. microbiology programs;

**2.** Design courses and lay down syllabi for the same;

**3.** Organize lectures, seminars and supervise the dissertation work etc;

**4.** Arrange to conduct theory and practical examination, evaluation of performance in day-to-day work, including tests, seminars, viva-voce etc.

**1.** Courses offered by the Department of Microbiology

| | |
|---|---|
| (a) B.Sc. (H) Microbiology | 3 Years |
| (b) M.Sc. Microbiology | 2 Years (four semester) |

**2. Eligibility for admission**

(a) Minimum qualifications
The minimum qualification for admission to the B.Sc. (H) Microbiology shall be as follows.
50% marks in any of the following examination with Physics, Chemistry, Biology or Biological Sciences.

(1) Intermediate Examination
(2) 10+2 Examination
The minimum qualification for admission to M.Sc. Microbiology shall be as follows.

(1)50% marks in B.Sc. (H) in Microbiology
(2) 50% marks in B.Sc. in any branch of Biological Sciences.

After all the test and interview in a case where two students get same number of marks, the preference shall be given to a student who has done B.Sc. (H) Microbioology.

(b) Those appearing for the final year of the qualifying examination shall also be eligible to apply, provided that they submit proof of having passed the final year

examination, with minimum requirements, at the time of admission/personal interview, if qualified and called for.

**3. Criteria for admission**

Admission to eligible candidates will be strictly on the basis of entrance test conducted by University.
NOTE: 15 % of the marks obtained in entrance test will be awarded as additional marks to all candidates to pass the qualifying examination from any Institute/College affiliated to Bundelkhand University, Jhansi.

**4. Normal Intake**

The intake for B.Sc. (H) Microbiology shall be sixty (60) while that of M.Sc. Microbiology shall be forty (40), However, the university may modify the normal intake as per needs. Statutory reservation, as applicable, shall be applicable as per University/State Government rules/norms.

**5. Medium of Instruction**

Medium of instruction and examination shall be English.

**6. Attendance**

Minimum attendance required to be eligible to appear in the examination for each paper shall be 75% of all class lectures (Theory and Practical).
In case a student is short of attendance due to illness, participation in sport, extra curricular activities etc the following rules shall apply.
(a) Shortage of up to 10% shall be condoned by the HOD on the specific recommendation by teacher of the department.
(b) A shortage of up to 25% can be condoned by the VC on the specific recommendations of the HOD
(c) Student will be allowed to go for training in Institution allover India with due permission from the HOD

The training period duly certified by the Head of the Department of the concerned Institution will be considered as normal attendance for the student.

**7. Duration of the course**

The duration of the course for B.Sc. (H) Microbiology shall be three (3) academic years. The duration of the course for M.Sc. Microbiology shall be (four (4) academic semester) two years.

**8. Examination**

Candidates for the examination of B.Sc. as well as M.Sc. Microbiology shall be required to pursue a regular course of study. The scheme of examinations shall be as follows-

**(i) Sessional**

Sessional examinations (for theory as well as practical) shall be conducted by the subject teacher as mentioned in the academic calendar of the department. The questions can be objective/short answer type and will be set by the concerned teacher. The weightage of this examination will be 30% for both B.Sc. as well as on sufficient grounds duly permitted by the HOD. The subject teacher shall conduct a separate examination for that student.

**(ii) Theory examination**

Semester examination and annual examination shall be conducted by the university as mentioned in the academic calendar of the department. The question paper will be set by examiners appointed by the Vice chancellor based on the recommendation of the board of studies. The University will decide the pattern of the question paper. The weightage of this examination will be 70% .

**(iii) Practical Examination**

A practical examination will be conducted in papers of the course as detailed along with the course titles. The examiners will be appointed by VC basis of the recommendations of the course committee and Board of studies. The marks of the practical examination for both B.Sc. and M.Sc. students will be distributed on the following basis.

(1) 25% based on the performance of the students in the practical experiments conducted in the department laboratory under the faculty in charge of the concerned practical. The students will have to submit a practical record to the faculty in charge.

(2) 50% based on the performance at the final practical examination.
25% based on the viva-voce conducted by the examiners.

(3) Student fails to appear in any practical examination of annual examination and semester examination due to my grounds including illness he/she shall be allowed to appear on the practical examination only after the payment of fees as the sessional will be carried over as such.
If a student fails again in year back examination in any year after given the 1st year B.Sc./M.Sc.2nd semester he/she will be dropped out from the course.
Special back paper examination will be conducted only for B.Sc. final year students and M.Sc. 4th semester students.

**(iv) Seminars**

Each student of M.Sc. previous year will have to deliver a seminar. Topic will be decided in consultation with the seminar leader. A committee will be formed by the seminar leader in consultation with the Head of the Department, which will

judge the student and award marks out of 100. The Head of the Department will decide seminar leader.

**(v) Maximum Marks**

Maximum marks for each paper for B.Sc. (H) as well as M.Sc. will be 100 for each theory as well as practical papers.

**(vi) Minimum qualifying marks**

The minimum passing marks will be 40% in the aggregate. The minimum pass marks, 40% have to be obtained in theory, sessional, practical and dissertation individually, on the basis of percentage of total marks secured in the aggregate of the semesters by a student, he/she will be awarded divisions, as detailed given below-

Third division: 40% or more but less than 50%
Second division: 50% or more but less than 60%
First division: 60% or more but less than 75%
First division with distinction: 75% or more

**(vii) Back paper examination**

In case the candidate is able to clear at least 50% theory paper in annual examination and at the end of the $2^{nd}$ semester (M.Sc.) examination and annual he/she have to clear remaining 50% in the coming year.

In case a student gets a year back, unable to clear 50% theory paper in $2^{nd}$ semester of M.Sc. and annual examination of B.Sc. $1^{st}$, $2^{nd}$ year examination, he/she will have to clear all the theory papers & practical examination with the junior batch (regular examination)

**(viii) Special Back**

University may also hold a special back paper examination after declaration of final year B.Sc. result and $4^{th}$ semester of M.Sc. result & only those students who will clear at lease 50% of theory papers of M.Sc. ($3^{rd}$ & $4^{th}$ semester) and B.Sc. $3^{rd}$ year. Special back paper may be allowed to only after B.Sc. $3^{rd}$ year result and M.Sc. $4^{th}$ semester result. Those students who have back paper in B.Sc. $1^{st}$, $2^{nd}$ and $3^{rd}$ year and M.Sc. $1^{st}$, $2^{nd}$ and $3^{rd}$ semester.

Vice Chancellor of Bundelkhand University, Jhansi will give the permission for special back paper.

**(ix) Improvement of Paper –**

A candidate may be allowed one chance to improve his/her division maximum upto 02 papers in next year subsequent examination of the course.

Improvement will not be entertained for Practical Examination.

## 9 Dissertation/Project work

Each M.Sc. student will have to undertake a project work/dissertation under the guidance of his/her supervisor for a period of 4-6 months which shall be of 200 marks. The student has to make the choice whether he/she desires to go for a dissertation in a Research Institute or Industry. The supervisors will be allotted by

the HOD to each of the students. The supervisors will be faculty members of the Microbiology Department.

The students will have the option of undertaking the project work in the Department Laboratory itself or in other, Institutions based on permission. If a student undertakes the project in an outside institution, the HOD of the concerned Department will be allotting one of its faculty members/Scientist as the supervisor to the student. One faculty member of the department of Microbiology. BU will be appointed as co-guide to those students who undertake their project work in other institutions.

**(i) Submission of Dissertation/Project work report**

The student will be allowed to submit his/her dissertation once the supervisor and co-supervisor is satisfied with the progress and completion of the research work. The project work should be an original research. The students who undertake their project work in the Department Laboratory of University will have to prepare four copies of the printed/typed thesis. One copy will be for the student, one for the supervisor, one for the department library and one will be for the university library. The student who undertakes their project work in other Institutions will have to prepare 5 copies of the thesis. One of which shall be for the co-guide.

The thesis should include an up to date review of literature in the concerned topic of the students project work, aim and objectives of the study, materials and methods, results and discussion and bibliography.

The thesis should include a certificate of original work carried out by the student duly signed by the candidate, supervisor, co-guide if present and the HOD of the department where the work was carried out.

Dissertation should be undertaken from 1$^{st}$ of January to onwards and must be submitted by 15$^{th}$ July of the session.

**(ii) Oral evaluation of the dissertation /Project report**

The student will have to defend his/her research work in front of an audience. The assessment of the project work shall be done jointly by the supervisor/co-guide, the course committee and an external examiner appointed by the Vice-Chancellor. On the recommendation of the course committee. The examiner should study the scientific utility and quality of the research work undertaken by the student. There will be 100 marks for thesis and 100 for presentation.

In case a student fails to submit his/her dissertation and gives the presentation before the scheduled date on any ground including illness, he/she shall e allowed to submit the dissertation and give the oral presentation on another date only after the deposition of penalty fee as per university norms and as permitted by VC in the above case the student should submit and present the dissertation with in four months of the original date. Otherwise he/she will be allowed with the junior batch (next year) only. In case a student fails to submit and present his/her dissertation after giving a last chance he/she has to present his/her work with their junior batch (next year), failing to do so even on the next year with junior batch student will be dropped from the course.

## 10. Course Program

### (a) B.Sc. (H) MICROBIOLOGY

List of course offered for B.Sc. Microbiology Program

**B.Sc. Part I**

Theory Marks 100X4=400
BSM 11 Chemistry I
BSM 12 Biophysical chemistry, Bioinformatics and Instrumentation
BSM 13 General Microbiology
BSM 14 Elements of Biochemistry
Practical-I 100
Practical-II 100
**Practical Marks 100X2=200**
**Two Practical based on BSM 11 & BSM 12 clubbed together and BSM 13 & 14 clubbed together.**
**Total=600**

**B.Sc. Part II**

Theory Marks 100X4=400
BSM 21 Elements of genetics
BSM 22 Microbial Metabolism
BSM 23 Ecology and Ecosystem
BSM 24 Food Microbiology
**Practical Marks 100X2=200**
**Two Practicals based on BSM 21 & BSM 22 clubbed together and BSM 23 & 24 clubbed together.**
**Total=600**

**B.Sc. Part III**

Theory Marks 100X4=400
BSM 31 Medical Microbiology and Immunology
BSM 32 Environmental Microbiology
BSM 33 Industrial Microbiology
BSM 34 Microbial Genetics and Biotechnology
**Practical Marks 100X2=200**
**Two Practicals based on BSM 31 & BSM 32 clubbed together and BSM 33 &324 clubbed together.**
**Total=600**

**Total marks=1800 (including both theory and practical marks in three years)**

**(b) Course program (Four semester program)**

**M.Sc. Part I**

**Semester-I**

Theory Marks 100X4=400
MSM 101 Fundamentals of Microbiology
MSM 102 Microbial Biochemistry
MSM 103 Tools and Techniques
MSM 104 Microbial Metabolism

Lab work 100X1=100

**Semester-II**

Theory Marks 100X4=400
MSM 201 Biostatistics and computer application
MSM 202 Industrial Microbiology
MSM 203 Microbial Genetics
MSM 204 Immunology

Lab work 100X1=100
Seminar 100X1=100

**Semester-III**

Theory Marks 100X4=400
MSM 301 Food Microbiology
MSM 302 Environmental Microbiology
MSM 303 Medical Microbiology
MSM 304 Molecular Biology

Lab work 100X1=100

**Semester-IV**

Project work 100 marks
Presentation and Viva 100 marks

**Total Marks- 500+600+500+200=1800**

**11. Discontinuation**

A candidate who has discontinued the academic programmed during any year/semester with permission from HOD will be permitted by the Vice-Chancellor to take readmission in the academic program at the beginning of the semester/year concerned, in a subsequent year, not however beyond a gap of two year, under the condition that the maximum period of stay in a course shall not exceed 4-6 years from the time of initial admission. Fee once paid shall not be refunded or adjusted during subsequent admission.

**12** the course fees and examination fee shall be decided by the university from time to time and have to be deposited by the candidate, as and when asked fro.

**13** The academic program may be conducted in collaboration with any other institutes where necessary facilities and available.

**14** The above rules are subjected to amendment by appropriate authorities of the university from time to time, as and when deemed necessary.

**15** If needed the course structure may be altered or updated by the board studies, or a committee appointed by the Vice Chancellor for the Department.

**16 Re-evaluation-**
Re-evaluation of answer sheets will not be allowed in any case.

**17 Award of Degree**
On completion of all academic requirements and on the recommendations of the HOD the university will award degree to the student.

**BUNDELKHAND UNIVERSITY, JHANSI-284128**

**CURRICULUM**

**M. Sc. MICROBIOLOGY**
**(Four Semesters)**

| Course | Paper code | Title of the paper | EA | IA | Total |
|---|---|---|---|---|---|
| SEM-I | | | | | |
| | MSM 101 | Fundamentals of Microbiology | 70 | 30 | 100 |
| | MSM 102 | Microbial Biochemistry | 70 | 30 | 100 |
| | MSM 103 | Tools and Techniques | 70 | 30 | 100 |
| | MSM 104 | Microbial Metabolism | 70 | 30 | 100 |
| | MSM-105 | Lab Course I | 70 | 30 | 100 |
| SEM-II | | | | | |
| | MSM 201 | Biostatistics and computer application | 70 | 30 | 100 |
| | MSM 202 | Industrial Microbiology | 70 | 30 | 100 |
| | MSM 203 | Microbial Genetics | 70 | 30 | 100 |
| | MSM 204 | Immunology | 70 | 30 | 100 |
| | MSM-205 | Lab Course II | 70 | 30 | 100 |
| SEM-III | | | | | |
| | MSM 301 | Food Microbiology | 70 | 30 | 100 |
| | MSM 302 | Environmental Microbiology | 70 | 30 | 100 |
| | MSM 303 | Medical Microbiology | 70 | 30 | 100 |
| | MSM 304 | Molecular Biology | 70 | 30 | 100 |
| | MSM-305 | Lab Course III | 70 | 30 | 100 |
| SEM-IV | | | | | |
| | MSM-401 | Project Work | -- | -- | 100 |
| | MSM-402 | Presentation and Viva | -- | -- | 200 |
| | | | | | |
| | | **Total Marks** | | | **1800** |

## MSM-101 – Fundamentals of Microbiology

**Unit-I**

1. History and Scope of Microbiology
2. Classification of Micro organism: Hackle's three kingdom concept, Whittaker's five-kingdom concept.
3. Classification and salient features of bacteria according to Bergey's manual of determinative bacteriology.

**Unit- II**

1. Culture media : defined, Complex Differential Selective and Minimal
2. Isolation Techniques : Pour plate, Spread plate , Streak Plate enrichment
3. Staining techniques: Simple staining, gram Staining, Acid fast Staining, Spore Staining, flagella staining capsule Staining Lacto phenol blue, (for fungi) Staining negative staining, and differential staining.
4. Cultivation of anaerobic bacteria and preservation of microbial cultures.

**Unit-III**

1. Principle of sterilization
2. Physical control of micro organism ;Heat, filtration and radiation
3. Chemical control of micro organism ;Halogen, phenol, phenolic compounds heavy metals alcohols ethylene oxide aldehydes and hydrogen peroxide
4. Sterilization by soaps, detergents and dyes.

**Unit-IV**

1. Morphology and ultra structure of bacteria, cell wall, cell membrane, cilia and pilli, capsule, flagella cytoplasmic inclusions
2. Bacterial nutrition tr4ansport of nutrients across the bacterial membrane.
3. Bacterial growth, growth kinetics growth rate and generation time factors affecting growth.
4. Growth of micro organism under extreme conditions: halophiles, Thermophiles, Acidophiles.

**Unit-V**

1. General morphology and Ultra structure of viruses, Envelope, Viral genome and viral related agents-Viroids and prions
2. Assay of viruses-Physical and Chemical methods, Serological methods, Purification of viruses
3. Animal viruses, Plant viruses and Bacteriophage.
4. Lytic and Lysogenic cycle of Virus.

## MSM-102 – Elements of Biochemistry

**Unit-I**

1. Carbohydrates: Classification, Structure, properties and functions. Homo and Hetero Polysaccharides.
2. Lipids: Classification, Structure, properties and functions of fatty acids, triacylglycerols, phospholipids, Wax, Sterols, terpenes.
3. Lipids with specific biological functions, Lipoproteins and biological membrane.

**Unit-II**

1. Amino Acids: Classification, Structure, properties and functions. Non protein amino acids.
2. Protein: Primary, Secondary and Tertiary and quaternary structure of polypeptides, Alpha and beta helix, constraints for polypeptide confirmation.
3. Nucleic acids: Structure of purine and Pyrimidine bases, nucleosides and nucleotides, Structural features of DNA and RNA.

**Unit-III**

1. Enzymes: Basic concepts, Discovery, Nomenclature and Classification.
2. Enzyme kinetics: Michaelis-Menton equation and Enzyme inhibition, reversible and irreversible inhibition.
3. Regulation of enzyme activity, Allosteric enzymes, Iso-enzymes.

**Unit-IV**

1. Lipid Metabolism: Biosynthesis and degradation of saturated and unsaturated fatty acids.
2. Overview of amino acid metabolism (details not required), Regulation of amino acid metabolism.
3. Nucleic acid metabolism and its regulation.

**Unit-V**

1. Vitamins: Classification, fat soluble and water soluble vitamins.
2. Structure and function of vitamins.
3. Major diseases caused due to deficiency of vitamins.

## MSM-103 – Tools and Techniques

### Unit-I

1. Centrifugation: Principle, types, differential and density gradient centrifugation.
2. Factors affecting centrifugation, types of centrifugation and its applications.
3. Polarography: Principles and its applications.

### Unit-II

1. Chromatography: Principle, types and applications of paper, thin layer and Gas chromatography.
2. Affinity chromatography
3. High Pressure Liquid chromatography (HPLC).

### Unit-III

1. Electrophoresis: Principle, types, and Applications.
2. Moving Boundary and Zonal electrophoresis(Paper, Gel electrophoresis)
3. Immunoelectrophoresis and isoelectric focusing.

### Unit-IV

1. Spectrophotometery: Principle of UV-Visible spectrophotometer
2. IR spectroscopy: Principle, instrumentation and applications.
3. Atomic absorption spectroscopy.

### Unit-V

1. Microscopy: Principle and application of light Microscopy.
2. Fluorescence, Phase contrast, Polarization microscopy.
3. Electron Microscopy (Scanning and Transmission electron microscopy).

## MSM-104 Microbial Metabolism

### Unit-I

1. Metabolism: General Concepts
2. Applications of Second Law of Thermodynamics.
3. Redox Potential, outline of intermediary metabolism.

### Unit-II

1. Free energy change of the reaction.
2. Catabolism and anabolism
3. ATP as high energy phosphate compound, ATP…….., Bacterial Photosynthesis.

### Unit-III

1. Calvin Cycle, Reductive TCA cycle,
2. Pathway of carbohydrate breakdown in microorganism: EMP,HMP and ED
3. Glyoxylate cycle; TCA Cycle.

### Unit-IV

1. Biological Nitrogen Fixation, Free living and symbiotic diazotrophic organism.
2. Biochemistry of N2 Fixation.
3. Nitrogenase and its regulation, Genetics of N2 Fixation-*nif genes* and their regulation.

### Unit-V

1. Nitrate and ammonia assimilation in Prokaryotes.
2. Methylotrophs and pathways of methane oxidation.
3. Assimilation of sulphur.

## MSM 201 Biostatistics and computer application

**Unit-I**

1. Importance and scope of statistics in biochemical experimentation.
2. Probability, Distribution, Binomial, Poisson distribution, addition and multiplication theorems.

**Unit-II**

1. Measure of central Tendency: Mean, median and mode
2. Measure of dispersion, range quality derivation, variance, standard deviation, coefficient of variance, confidence limits of population mean, tests of significance, student 'T' test, chi square test.

**Unit-III**

1. ANOVA : One way & two way ANOVA Anderson scattrered.
2. Linear regression: regression diagram, regression coefficient relation between regression and correlation.
3. Test of goodness of fit and test of independence of attributes.

**Unit-IV**

1. An introduction to bio-informatics: biological research on the web, phylogenetic analysis, sequence alignment
2. Introduction to information expression

**Unit-V**

1. Introduction to computers, basis architecture, generation of computer hardware and software operating system- WINDOWS & UNIX system.
2. Introduction to internet, LAN, MAN and WAN; application of computers in Microbiology.

# MSM 202 Industrial Microbiology

## Unit-I

1. Scope and history of industrial microbiology, fermentation, range of fermentation process, component of a fermentation process.
2. Isolation, screening and improvement of industrially important microorganisms

## Unit-II

1. Fermentor design: basic function of a fermentor, fermentor design, types of fermentor, factors affecting fermentation process (pH, aeration, agitation , temperature, foam etc)
2. Basic concepts of solid state, batch and continuous fermentation.

## Unit-III

1. Fermentation media: typical media, various energy sources, carbon and nitrogen sources
2. Media sterilization, screening of various media and inoculums preparation.

## Unit-IV

1. Recovery and purification: recovery of microbial cells and other solid matter, precipitation, filtration, centrifugation, cell disruption, drying, crystallization.
2. Scale up of fermentation process.

## Unit-V

1. Microbial Production of Penicillin, lactic acid.
2. Microbial products: Ethyl alcohol, beer, wine, protease, and lipase

## MSM-203 Microbial Genetics

**Unit-I**

1. DNA as a genetic material, structure of DNA and RNA
2. DNA replication
3. Genetic code, central dogma, reverses transcriptase, polymerases.

**Unit-II**

1. Genetic recombination in bacteria: transformation, transduction and conjugation.
2. Molecular aspects of genetic recombination
3. Use of transformation, transduction and conjugation in genetic mapping.

**Unit-III**

1. RNA and protein synthesis, transcription in prokaryotes.
2. Translation
3. Regulation of gene expression in bacteria by induction, repression, attenuation and catabolite repression.

**Unit-IV.**

1. Types of mutation, physical and chemical mutagens.
2. Molecular mechanism of mutation, forward and reverse mutation.
3. DNA damage (Pyrimidine dimmers)and DNA repair (various mechanism of repair)

**Unit-V**

1. Extra chromosomal genetic material
2. Plasmid and their types, plasmid as vectors for gene cloning
3. Functions of Transposons and plasmids.

## MSM-204 Immunology

**Unit-I**

1. Infection: Sources of infection, vehicles or reservoirs of infection, spread of infection.
2. Types of infection. Predisposing factors.
3. Inflammation: signs and mechanism, acute and chronic inflammation.
4. History of immunology, growth of immunology as a discipline

**Unit-II**

1. Immune response: innate immune mechanisms
2. Adaptive immune response.
3. Anatomical organization of immune system: Primary lymphoid organs secondary lymphoid organs.
4. Cells of the immune system: Mononuclear cells and granulocytes, antigen presenting cells, lymphocytes and their subsets.

**Unit-III**

1. Antigens and Hapten: Structure, properties and types.
2. Immunoglobulins: structure, heterogenecity types, subtypes and properties.
3. Complement system: structure, components, properties and functions of complement components, biological consequences of complement activation.
4. Autoimmunity, immunodeficiency syndromes.

**Unit-IV**

1. antigen-antibody reaction: agglutination, precipitation
2. Complement fixation, and immuno fluorescence
3. ELISA, RIA

**Unit-V**

1. Major Histo-compatibility MHC complex
2. Hypersensitivity: definition and classification, IgE-mediated hypersensitivity, mechanism of mast cell degranualation, mediators of type I reaction and consequences.
3. Type II hypersensitivity. Antibody dependent cell mediated cyto-toxicity.
4. Type III and IV immune complex mediated hypersensitivity.

## MSM-301 Food Microbiology

**Unit-I**

1. Micro-organisms important in food microbiology: yeast, bacteria general characteristics and importance.
2. Principles of food preservation, preservation by high temperature, low temperature, drying and desiccation
3. Preservation by chemical and radiation

**Unit-II**

1. Microbiology of milk: sources of micro-organisms in mild & types of micro organisms in milk, pasteurization of milk
2. Microbiological examination of milk (Standard plate count, direct microscopic count, reductase test, phosphates test)
3. Dairy products from microbes: butter , yogurt and cheese

**Unit-III**

1. Microbial spoilage of food, biochemical changes caused by microbes during spoilage of fist, meat poultry, eggs, fruits and vegetable
2. Factors influencing microbial growth in food.

**Unit-IV**

1. Classification of food born diseases
2. Food born infections: Brucella, Bacillus, Clostridium, Vibrio, Salmonella, Shigella, *E.Coli*.
3. Food intoxication: Staphylococcal intoxication, clostridial poisoning

**Unit-V**

1. Fermented food: Bread, malt beverages soy sauce, tempeh.
2. Micro organisms as source of food: single cell protein (SCP)
3. Mushroom and food value of mushrooms.

## MSM-302 Environmental Microbiology

### Unit-I

1. Ecosystem management and role of microbes
2. Microbial life in extreme environment
3. Enumeration of micro organisms, control of air borne micro organisms
4. Disease caused by air born microblora

### Unit-II

1. Water microbiology: microbial assessment of water quality, test for coli forms (presumptive test, confirmed test completed test), MPN test
2. Water Purification
3. Water born disease and their control measures
4. Microorganisms of sewage, sewage treatments procedure: physical treatment and biological treatment

### Unit-III

1. Microbial degradation of xenobiotic compounds
2. Microbial degradation of hydrocarbons and substituted hydrocarbons
3. Hazardous waste management
4. Ecological consideration of biodegradation

### Unit-IV

1. Bioremediation
2. Methanogens and the process of methanogenesis, ecological role of methylogens.
3. Non conventional energy sources

### Unit-V

1. Bio-fertilizers and bio-pesticides
2. Bioleaching and their ecological importance
3. Microbial toxins
4. Environmental Impact assessment (EIA)

## MSM-303 Medical Microbiology

**Unit-I**

1. Early discovery of pathogenic micro-organisms. Classification of medically important micro organisms.
2. Normal micro flora of human body
3. Pathogenecity of Micro organisms: Virulence factors, establishment, spreading and tissue damage
4. Mechanisms of bacterial adhesion, colonization and invasion of mucous membranes of respiratory, enteric and urogenital tracks.

**Unit-II**

1. Air born diseases: diphtheria, pertusis and tuberculosis
2. Food and Water born diseases: typhoid, shigellosis and cholera
3. Soil born disease: Anthrax, Tetanus and gas gangrene.
4. Contact bacterial disease: leprosy and bacterial conjunctivitis.

**Unit-III**

Etiology, geographical distribution, pathogenesis, symptomatology, lab diagnosis, pathology, differential diagnosis, epidemiology and treatment of following diseases

1. Candidiasis
2. Histoplasmosis
3. Aspergilosis
4. Cryptococcosis

**Unit-IV**

1. Pneumotropic viral diseases: influenza
2. Dermotropic viral disease: Herpes simplex, chicken pox, small pox, measles and rubella.
3. Viscerotropic viral diseases: Dengue fever, hepatitis and Acquired immuno deficiency syndrome (AIDS)
4. Neuro tropic viral disease: rabies, poliomyelitis and slow virus disease.

**Unit-V**

1. Bacterial Zoonoses: Brucellosis, bubonic plague, and salmonellosis
2. Viral Zoonoses: Encephalitis and yellow fever.
3. Dermatomycosis: Trichophyton, Microsporum, Epidermatophyton. Morphological and cultural characters of dermatophytes, Division of dermatophytes according to the site of infection.

# MSM-304 Molecular Biology

## Unit-I

1. Nucleic acid as genetic information carriers: experimental evidences
2. Concept of gene and genome, organization in prokaryotes
3. Genome size-C-value paradox, DNA denaturation and renaturation

## Unit-II

1. Gene as a unit of mutation and recombination. Molecular nature of mutations: mutagens, spontaneous mutation-origin
2. DNA damage and repair: type of DNA damage (deamination, oxidative damage, alkylation's and Pyrimidine dimmers) SOS repair.
3. DNA polymerases: *E.coli* DNA polymerases, DNA polymerase as proof reader and editor, DNA ligase, asymmetric and dimeric nature of DNA polymerase III.
4. DNA replication: general principles, various modes of replication unwinding of DNA helix. Continuous and discontinuous synthesis of leading and lagging strands.

## Unit-III

1. structural features of RNA (rRNA tRNA and mRNA)
2. Transcription: General principles, basic apparatus types of RNA polymerases
3. Steps of Transcription: initiation, elongation and termination. Inhibitors of RNA synthesis.
4. Control of Transcription by interaction between RNA polymerases and promoter regions, use of alternate sigma factors, controlled termination: attenuation and anti-termination.

## Unit-IV

1. Maturation and processing of RNA: methylation, cutting and trimming of rRNA capping, polyadenylation and splicing of mRNA: cutting and modification of tRNA degradation system
2. Genetic code: Nature of genetic code, codon, anti codon, pairing, wobble hypothesis.
3. Protein synthesis: steps, details of initiation, elongation and termination
4. Inhibitors of protein synthesis, signal hypothesis.

## Unit-V

1. Regulation of gene expression: Operon concept, induction and expression, lac operon
2. Positive and negative control
3. catabolite repression
4. Transposable elements in prokaryotes

**BUNDELKHAND UNIVERSITY, JHANSI-284128**

**CURRICULUM**

**B.Sc. (H) MICROBIOLOGY**
**(Three Year)**

| Course | Paper code | Title of the paper | EA | IA | Total |
|---|---|---|---|---|---|
| B.Sc. I yr | | | 70 | 30 | 100 |
| | BSM 11 | Chemistry I | 70 | 30 | 100 |
| | BSM 12 | Biophysical chemistry, Bioinformatics and Instrumentation | 70 | 30 | 100 |
| | BSM 13 | General Microbiology | 70 | 30 | 100 |
| | BSM 14 | Elements of Biochemistry | 70 | 30 | 100 |
| | BSM-15 | Lab Course-I | -- | -- | 100 |
| | BSM-16 | Lab Course-II | -- | -- | 100 |
| B.Sc. II yr | | | | | |
| | BSM 21 | Elements of genetics | 70 | 30 | 100 |
| | BSM 22 | Microbial Metabolism | 70 | 30 | 100 |
| | BSM 23 | Ecology and Ecosystem | 70 | 30 | 100 |
| | BSM 24 | Food Microbiology | 70 | 30 | 100 |
| | BSM-25 | Lab Course-III | -- | -- | 100 |
| | BSM-26 | Lab Course-IV | -- | -- | 100 |
| B.Sc. III yr | | | | | |
| | BSM 31 | Medical Microbiology and Immunology | 70 | 30 | 100 |
| | BSM 32 | Environmental Microbiology | 70 | 30 | 100 |
| | BSM 33 | Industrial Microbiology | 70 | 30 | 100 |
| | BSM 34 | Microbial Genetics and Biotechnology | 70 | 30 | 100 |
| | BSM-35 | Lab Course-V | -- | -- | 100 |
| | BSM-36 | Lab Course-VI | -- | -- | 100 |
| | | **Total Marks** | | | **1800** |

# B.Sc. (H) MICROBIOLOGY PART-I

## BSM-11 General Chemistry

**Unit-I**

1. Periodic table: Modern periodic table, periodicity in properties of elements, atomic radii, ionic and covalent radii, ionization energy.
2. Electro negativity, Electron-affinity, Lanthanide contraction, inert pair effect.
3. General Properties of 3rd elements and co-ordination compounds. Position in Periodic Table. General properties of 3-A elements.

**Unit-II**

1. Acids and bases: Elementary idea of Bronsted-Lowry and Lewis concept of acids and bases (proton-donor acceptor and electron-donor acceptor systems)
2. Relative strengths of Lewis acids and bases and the effect of substituents and the solvent on them.
3. Concept of leveling and differentiating solvents. Hard soft Acid base (HSAB)

**Unit-II**

1. Chemical bonds and Molecules: Characteristics of covalent bond, Ionic bond , co-ordinate bond, Vanderwaal, Hydrogen-Bond, and Metallic Bond.
2. Factors affecting the formation of ionic/covalent compounds, born-haber cycle, Fajan's Rule.
3. Shapes of molecules, bond length, and bond order, bond angle, concept of resonance, valence bond theory (hybridization). VSEPR concept, structure of water.

**Unit-IV**

1. Molecular compounds, IUPAC nomenclature, werner's coordination theory, EAN rule, isomerism in coordination compounds.
2. Discussion of VBT and CFT. Role of tracer elements (Na, K, Mg, Ca, Mo, Fo, Cr, Mo, Co).
3. Wholer's synthesis of urea, concept of functional group, nomenclature and isomerism, hemolytic and heterolytic fission

**Unit-V**

1. Types of reaction (addition, elimination, substitution and rearrangement) resonance vs tautomerism.
2. Aldol condensation Hoffman-bromide reactions, Pinacol-Pinacolone rearrangement, Beckmann rearrangement, cannizzaro reaction, Friedel-craft reaction
3. Orientation in Benzene (Disubstitution) reactive intermediates (carbonium ion, carbonian, free radical carbenes)

**BSM 12 Biophysical chemistry, Bioinformatics and Instrumentation**

**Unit-I**

1. Applications of laws of physics to biological fields
2. Thermodynamics-zero, first, second and third law of thermodynamics

**Unit-II**

1. Computer evolution-The history of computers, categories of computers (Application wise), characteristics of computer, types of computer (Analog, digital, hybrid) Mini, Mainframe, super computer, limitation of computers.
2. Computer organization-The block diagram of digital computer, C.P.U., A.L.U. Main components of CPU data bases, main memory, secondary memory, RAM, ROM. DEVICES Input devices, output devices, secondary storage devices, magnetic tape, magnetic disk, floppy disk

**Unit-III**

1. Number system and computer arithmetic-base/radix, decimal numbers, binary Numbers, Numbers, Hexa Decimal Numbers with conversions and basic operations, encoding system (BCD, ASCII, EBCDIC, CODES)
2. Concept of soft-ware and data organization-computer languages, operating system, data base management system, data communication, concept of computer networking
3. Operating system introduction to type of operating system, UNIX, MS-DOS, Type of languages, Lotus, Word star, Windows.

**Unit-IV**

1. Microscopy: General principle and working of microscopes.
2. Light microscope, dark field, phase contrast microscope, electron microscope (SEM and TEM)
3. Centrifugation: Basic Principle, Instrumentation and applications.

**Unit-V**

1. Sterilization: Principles and mechanisms of sterilization
2. Filtration and physical methods of sterilization (dry and moist heat sterilization)
3. Chemical methods of sterilization.

## BSM 13 General Microbiology

### Unit-I

1. Introduction: History, scope and importance of microbiology with reference to the work of antonym van leeuwenhoeck, Louis Pasteur, and Edward Jenner, Robert Koch, Alexander Fleming, Waksman, Beadle and Tatum.
2. Cellular organization of prokaryotic and Eukaryotic cells.
3. Difference between prokaryotes and eukaryotes, Importance and uses of microbes

### Unit-I

1. Bacteria: Morphology, fine structure and reproduction of bacteria
2. Classification of bacteria
3. General characteristics, structure, reproduction and importance of Mycoplasmas, Cyanobacteria and actinomycetes

### Unit-III

1. Viruses: structure and composition of viruses, polyhedral symmetry, helical symmetry, complex symmetry
2. Classification of viruses
3. Lytic and lysogenic cycles, bacteriophage

### Unit-IV

1. Algae-Systematic position of major taxa with evolutionary tendencies among them with regard to their vegetative structure
2. Asexual and sexual reproduction
3. Cyhanobacteria- a general accond with reference to Nostoc and Anabaena

### Unit-V

1. Fungi-Systematic position of major taxa with evolutionary tendencies among them with regard to their vegetative structure
2. Asexual and Sexual reproduction

## BSM 14 Fundamentals of Biochemistry

### Unit-I

1. Water-properties and biological significance: intermolecular forces, ionization
2. Acids and bases, dissociation of water, concept of pH, buffer solution
3. Properties of solution (diffusion, osmosis and osmotic pressure, dialysis) colloidal state, Donnan equilibrium.

### Unit-II

1. Carbohydrates: monosaccharide, oligosaccharides, polysaccharides. Biological functions of carbohydrates
2. Lipids: classification of lipids and fatty acids, biological role of lipids
3. Nucleic acids: structure of nucleosides and nucleotides. Structure and types of DNA and RNA

### Unit-III

1. Amino acids: classification and structure of amino acids. Acid base property of amino acids. Non-protein amino acids.
2. Proteins: classification of proteins, biological functions of proteins. The primary structure, secondary, tertiary and quaternary structure of polypeptides (outline only)
3. Determination of amino acid sequence

### Unit-IV

1. Enzymes: Discovery, nomenclature and classification, nature of enzymes
2. Mode of action of enzymes, regulation of enzyme activity, factors affecting enzyme activity
3. Enzyme Inhibition , Allosteric enzyme, Iso enzymes.

### Unit-V

1. Vitamins: Discovery and Natural sources of vitamins
2. Classification of vitamins (fat soluble and water soluble vitamins)
3. Functions and biological properties of vitamins.

## B.Sc. (H) MICROBIOLOGY PART-II

## BSM 21 FUNDAMENTALS OF GENETICS

### Unit-I

1. History of Genetics: Pre and post mendelian concepts
2. Mendel laws of Inheritance, Deviations from Mendelian laws,
    (i) Allelic interaction: incomplete dominance, codominance, over dominancel lethal genes
    (ii) Non-allelic interactions: epistasis, complimentary genes, inhibitory and duplicate genes

### Unit-II

1. Chromosome structure- Organization and morphology, special types of chromosome-Lampbrush and Polytene chromosome.
2. Chromosome theory of inheritance: Linkage and crossing over, gene mapping, concept of multiple alleles and pseudo-alleles, Extra-chromosomal genome.

### Unit-III

1. Chemical basis of Heredity-Evidence of the DNA and RNA as genetic material
2. Watson and crick model of DNA, Z-DNA, DNA replication-mode and mechanism of DNA replication, genetic code.

### Unit-IV

1. Mutation: mutation types, physical and chemical mutagens, molecular basis of mutation, practical application of mutation.
2. DNA Damage and repair.

### Unit-V

1. Cell division-Mitosis and meiosis, comparison of meiosis and mitosis
2. Sex determination and sex-linked inheritance, chromosomal aberrations

## BSM-22 MICROBIAL METABOLISM

**Unit-I**

1. An overview of metabolic process. Chemistry of microbial cell( Bacteria, virus, algae and fungi)
2. Physiology of growth-Microbial nutrition and growth dynamics in solid liquid, batch, continuous and chemostate cultures effect of physical and chemical factors on growth of microorganisms.

**Unit-II**

1. Transport of nutrient transport across the bacterial membrane.
2. Bacterial photosynthesis $CO_2$ fixation- a general account.

**Unit-III**

1. Carbohydrate metabolism : Glycolysis,(EMP), HMP and ED Pathway
2. Electron transport and oxidative phosphorylation in microbes- a general survey

**Unit-IV**

1. Role of Microbes in cycling of nitrogen in nature. Nitrification and de-nitrification
2. Nitrogen fixation, Nitrogenase and its mechanism of action. Regulation of nitrogen fixation by $O_2$ and combored nitrogen sources.

**Unit-V**

1. Secondary metabolism - a general account
2. Vitamins, hormones, toxins, bacteriocins with and their application.

## BSM-23 ECOLOGY AND ECOSYSTEM

**Unit-I**

1. Historical developments and the significance of ecology.
2. Definition of ecology and ecosystems, components of ecosystems, levels of organization, biosphere, energetic, trophic levels, food chains and food webs, ecological pyramids, synecology and autecology.

**Unit-II**

1. Microorganisms in their natural environments
    (a) terrestrial environment
    (b) aquatic environment
    (c) air/ atmosphere

**Unit-III**

1. Biogeochemical cycling and applied aspects of Microbial ecology
    (a) Role of microorganism in cycling of carbon, nitrogen, phosphorous and sulphur
    (b) Solid waste managemtn

**Unit-IV**

1. Ecological aspects of bio-eterioration and its control
2. Microorganisms and pollution problem
3. Microbes in mineral recovery
4. Eco-Friendly products

**Unit-V**

1. Microbial population dynamics-A general account
2. structure and development of microbial communities and exosystems (Succession of microflora in decomposing plant materials)
3. Non conventional energy sources

## BSM-24 FOOD MICROBIOLOGY

**Unit-I**

1. Food and microbes: food as substrate for microbial growth, sources for food contamination, Biochemical changes in food by microorganisms
2. Fermented Foods: Bread, malt beverages, wine, milk, tea, coffee, cocoa, vanilla, soy sauce, tempeh and idli.

**Unit-II**

1. Food preservation: High and low temperature, irradiation drying and food additives.
2. Preservation of vegetable and fruits, milk and milk products and canned foods.

**Unit-III**

1. Food poisoning and food infections: sources, symptoms and preservation of food borne bacterial and fungal disease.
2. Quality control of food products: Analytical methods and standards for raw, canned and fermented food.

**Unit-IV**

1. Microbiology of milk and dairy products
2. Sources of microorganisms in milk. Types of microorganisms in Milk.

**Unit-V**

1. Pasteurization of milk, dairy products from microorganisms- butter, yogurt, cheese, cultured milk products.
2. Microbial examination of milk-the standard plate count (SPC), direct microscopic count (DMC), the methylene blue reductase and phosphatase test.

## B.Sc. (H) MICROBIOLOGY PART-III

## BSM-31 IMMUNOLOGY AND MEDICAL MICROBIOLOGY

### Unit-I

1. History of immunology, cells and organs of immune system, innate and adaptive immunity
2. Antigen: Hapten, Epitopes, Adjuvant
3. Immunoglobulins: types, structure and functions.

### Unit-II

1. Antigen and antibody interactions, immuno-electrophoresis, RIA, ELISA, ELISPOT and FACS
2. Major Histocompatibility complex (MHC): structure and functions
3. Hypersensitivity reaction: type I, II, III & IV

### Unit-III

1. Transplantation immunology: immunological basis of graft rejection, Immuno-suppressive therapy
2. Autoimmunity, autoimmune diseases, organ specific/systemic
3. Immunodeficiency diseases: SCID & AIDS. Hybridoma technology

### Unit-IV

1. Introduction and Historical account of medical microbiology with important discoveries, a brief account of different pattern of diseases.
2. Brief account of symptomatology, clinical diagnosis & antimicrobial therapy of typhoid, tuberculosis, cholera, dermatiomycosis, candidiasis and aspergillosis.

### Unit-V

1. Study of important viral diseases: symptoms and clinical diagnosis of influenza, meseals, hepatitis virus A & b and oncogenic virus.
2. General account of protozoan diseases: symptoms, clinical diagnosis and microbial therapy of kala-azar, malaria and dengue
3. Brief account of routinely employed diagnostic tests in microbial diseases culture, smear, biochemical tests and anti-microbial testing.

## BSM-32 ENVIRONMENTAL MICROBIOLOGY

### Unit-I

1. Introduction and historical background of soil microbiology
2. Role of microbes in weathering of minerals and soil formation.
3. Components of soil, texture and classification of soils and soil profile.

### Unit-II

1. Soil microflora- bacteria, fungi, actinomycetes, algae, protozoa and viruses,
2. Degradation of pesticides
3. Interactions among soil microorganisms: neutralism, symbiosis, protocooperation, commensalisms, ammensalism, parasitism and predation.

### Unit-III

1. Composition of sewage, kinds of sewerage systems-sanitary, storm and combined sewers
2. Microorganisms in sewage-fungi, protozoa, algae, bacteria and viruses.
3. Sewage treatment and disposal

### Unit-IV

1. Water pollution: physical, chemical and biological characteristic of water, causes of water pollution
2. Effect of water pollution, control measures of water pollution.
3. COD and BOD

### Unit-V

1. Acid mine drainage
2. Microbial conversion of nitrate
3. Microbial methylations
4. microbial accumulation of heavy metals
5. Biodegradation of xenobiotic compounds

## BSM-33 INDUSTRIAL MICROBIOLOGY

**Unit-I**

1. Scope and historical development of industrial microbiology
2. Isolation, maintenance, preservation and improvement of industrially important microbial strains
3. Fermentation, types of fermentation, components of fermentation

**Unit-II**

1. Fermentor design
2. Types of Fermentor
3. Factors affecting fermentation processes-pH, temperature, aeration, agitation etc.

**Unit-III**

1. Scale up of fermentation
2. Down stream processing of fermentated products
3. Application of fermentation

**Unit-IV**

Microbial production of-

1. Antibiotics-penicillin and streptomycin
2. Aminoacids- L-lysine, L-glutamic acid
3. Enzymes-@ amylase, protease
4. Vitamins-B 12, riboflavin

**Unit-V**

Microbial production of-

1. Organic acid: lactic acid, citric acid
2. Bacterial insecticides
3. Single cell protein-Production and applications
4. Ethyl alcohol, bear,wine

## BSM-34 MICROBIAL GENETICS AND BIOTECHNOLOGY

**Unit-I**

1. Introduction: microbes as tools in genetics
2. Genetic mobile elements: basic principles of microbial genetics

**Unit-II**

1. Genetic recombination in: bacterial conjugation, transformation and transduction.
2. genetic code, gene mapping

**Unit-III**

1. Introduction to basic biotechnology-Principle of biotechnology
2. Screening, selection and improvement of Microbial strains.

**Unit-IV**

1. Recombinant DNA technology-basic concepts, restriction endonucleases, basis of restriction digestion.
2. Construction of recombinant DNA, basic procedures involved in a recombinant DNA experiment.

**Unit-V**

1. Vectors: Plasmids, Cosmids, Phagemids Lambda phages. Expression vectors.
2. Application of recombinant DNA in microbial technology.