University of Patanjali
Haridwar

Accredited by NAAC with 'A^{+}' grade

Department of Allied &Applied Science

Syllabus

National Education Policy 2020

For

B.Sc. Microbiology (2025-28)

UNIVERSITY OF PATANJALI, HARIDWAR

FACULTY OF SCIENCE,

DEPARTMENT OF ALLIED & APPLIED SCIENCE

Structure of Microbiology Syllabus

Session 2025-28

Semester	Core/Major	Minor	ID	AEC	SEC	VA	Total Credits
1	General Microbiology and Microbial Diversity (5+1)=6	Cell Biology (3+1=4)	Chemical Science (3+1=4)	Communicative English (3)	Environment and Ecology (3)	Foundation of yoga (2)	22
2	Bacteriology and Virology (5+1)=6	Biophysics (4)	Computer Application (3+1)=4	Advanced Communicative English (3)	Medicinal Plants (3)	Sanskar (2)	22
3	Medical Parasitology and Mycology (5+1=6)	Basics of Immunology (3+1=4)	Organic Chemistry (3+1=4)	Biostatistics & Data Science (3)	Herbal Drug Development (2+1)	Yagya Chikitsa (2)	22
4	Microbial Physiology and Metabolism (3+1=4)	Food & Dairy Microbiology (3+1=4)	Genetics (3+1=4)	Industrial Microbiology (3+1=4)	Instrumentation (3+1=4)	IKS (2)	22
5	Soil and Agricultural microbiology (3+1=4)	Molecular biology (3+1=4)	Bioinformatics (3+1) = 4	Bioprocess Technology (3+1=4)	Microbial Diagnostic and Health Clinic (3+1=4)	Internship/ Review Paper/ Industrial Visit (2)	22
6	Advances in Microbiology (3+1=4)	Haematology (3+1=4)	IPR, Bio-safety and Bioethics (4)	Recombinant DNA Technology (3+1=4)	Dissertation work/ Research Paper (3)	Biomaterials (3)	22

(Dr Laxmi Shankar Rath)
Head of the Department

(Dr A. K. Singh)
Dean

H.O.D/Coordinator
Department of Allied & Applied Science
University of Patanjali, Haridwar

1ST SEMESTER

University of Patanjali, Haridwar

Syllabus of B.Sc. Microbiology under NEP

Core Course

COURSE DETAILS

SUBJECT TITLE: General microbiology & Microbial Diversity

SUBJECT CODE: - BSMB-MJ-101

SEMESTER – I

CREDITS: 6 (Theory 5 and Practical 1)

Course Objectives:

1. To learn the basics of microbiology including, historical events
2. To understand about the types of microscopy and intricate details of the bacterial cell.
3. To appreciate various methods of sterilization employed to ensure aseptic conditions in microbiology works
4. To know about the types of culture media employed to isolate the microorganisms

Course Outcomes:

CO1: Thorough knowledge and understanding of concepts of Microbiology.

CO2: Learning and practicing professional skills in handling microbes.

CO3: Thorough knowledge and application of good laboratory and good manufacturing practices in microbial quality control.

	Theory	Practical	Tutorial
Credits	5	1	-
Hrs/Week	5	2	-
SCHEME OF EXAMINATION			
Total marks: 150			
Theory:100		**Practical:50**	
Final Exam (SEE)	**Internal Assessment (CT+TA)**	**Final Exam (SEE)**	**Internal Assessment (CT+TA/PR)**
75	**25**	**37**	**13**

Unit -1 **10 hrs**

Historical development and origin of microorganisms. Theory of spontaneous generation, Biogenesis and Abiogenesis. Contributions of international and Indian scientists in the field of

Microbiology. .Scope of microbiology as a modern and allied Health science. Branches of Microbiology. Ultrastructure of bacteria, cell envelope, cell wall– Gram positive and Gram negative bacterial cell wall, slime, flagella, capsule, pili.

Unit -2. **10 hrs**

Microscopy- a) Simple and Compound Microscope b) Dark field microscope c) Fluorescence Microscope d) Electron Microscopy -TEM and SEM. Stains and Staining Techniques. principle, procedure, and applications of a) Simple staining - negative staining b) Differential staining - Grams and Acid fast staining c) Structural staining - Cell wall, Endospore, Flagella and Capsular staining.

Unit -3 **10 hrs**

Sterilization Techniques 1. Definition of terms -sterilization, disinfectant, antiseptic, sanitizer, germicide, microbicide agents, micro biostatic agents, and antimicrobial agents. 2. Evaluation of antimicrobial chemical agents -Tube dilution and agar plate techniques 3. Physical methods of control - Principle, construction, and application of - Boiling, Pasteurization, Fractional sterilization -Tyndallisation, Moist heat sterilization under pressure - Autoclave. Dry heat sterilization - Incineration and hot air oven Filtration - Diatomaceous earth filter, Seitz filter, Membrane filter, and Laminar air low Radiation - Ionizing radiation –γ rays and non-ionizing radiation -UV rays 4. Chemical methods of sterilization: Alcohol, aldehydes, phenols, halogen, metallic salts, quaternary ammonium compounds, and sterilizing gases as antimicrobial agents.

Unit -4. **10 hrs**

Culture media and pure culture techniques. Culture and media preparation – solid and liquid. Types of media –semi synthetic, synthetic, enriched, enrichment, selective and differential media. Pure culture techniques – tube dilution, pour, spread, streak plate. Anaerobic cultivation of bacteria. Anaerobic culture techniques. Sterilization and disinfection; Antimicrobial chemotherapy. Preservation of microorganisms: Methods of preservation, slant culture, stab culture, soil culture, mineral oil overlaying, glycerol preservation, Lyophilisation. Methods of bacterial identification-morphological, physiological, biochemical and serological properties. Physiology of microbial growth and nutrition. Batch – continuous - synchronous cultures; Growth Curve. Nutritional requirements. Transport of nutrients by active and passive transport. Sporulation. Respiration, Fermentation. Photosynthesis - oxygenic and anoxygenic.; Bio-geo chemical cycles.

Unit -5. **10 hrs**

Prokaryotic microorganisms Overview of prokaryotic cell structure: Size, shape, arrangement. Ultra structure of prokaryotic cell: bacterial and archaeal - cell wall and cell membrane. Components external to cell wall - capsule, slime, s-layer, pili, fimbriae, flagella; structure, motility, chemotaxis. Cytoplasmic matrix - Cytoskeleton, ribosome, inclusion granules: Composition and function. Nuclear Material – bacterial structure (its differences with the Eukaryotic chromosome); Extra

Chromosomal material. Bacterial Endospore - Examples of spore forming organisms, habitats, function, formation and germination. Reproduction in bacteria.

Unit -6 **10 hrs**

Eukaryotic microorganisms - Overview of eukaryotic cell: Types of cells; Structure and function of organelles cell wall, cell membrane, cytoplasmic matrix, cytoskeleton, endoplasmic reticulum, Golgi complex, peroxisomes, lysosomes, vesicles, ribosomes, mitochondria, chloroplast and nucleus. Structure and functions of flagella. Reproduction in fungi-vegetative, asexual and sexual.

Suggested Reading:

1. Aneja K.R., Experiments in Microbiology, Plant pathology, Tissue culture and Mushroom cultivation, New C Age International, New Delhi.
2. Atlas R.M., Microbiology -Fundamentals and applications, Macmillan Publishing Company, New York.
3. Benson Harold J., Microbiological Applications, WCB McGraw- Hill, New York.
4. Brock T .D. and Madigan M. T., Biology of Microorganisms, Prentice Hall of India Private Limited.
5. Narayanan P., Essentials of Biophysics, New Age International, New Delhi.
6. Pelczar M.J., Chan E.C.S. and Krieg N.R., Microbiology, McGraw Hill Book Company, New York.
7. Prescott Lansing M., Harley John P. and Klein Donald A., Microbiology, WCB McGraw-Hill New York,
8. Salle A.J., Fundamental Principles of Bacteriology, Tata McGraw- Hill Publishing Company Limited, New Delhi.
9. Stanier R. Y., Ingraham J.L., General Microbiology, Prentice Hall of India Private Limited, New Delhi,

BSMB--MJ-101-P GENERAL MICROBIOLOGY (PRACTICAL) TOTAL HOURS: 30 CREDITS: 1

1. Microbiological laboratory standards and safety protocols.
2. Operation and working principles of light and compound microscope.
3. Working principle and operations of basic equipment's of microbiological laboratory (Autoclave, oven, incubator, LAF, pH meter, spectrophotometer, colorimeter, vortex, magnetic stirrer etc.).
4. Isolation and identification of microorganisms from natural sources (Algae, Yeast, filamentous fungi and protozoa).
5. Bacterial motility by hanging drop method.
6. Simple staining – Negative staining.
7. Differential staining – Gram staining.

8. Acid fast staining.
9. Structural staining – Flagella and capsule.
10. Bacterial endospore staining.
11. Staining of reserved food materials (granular).
12. Staining of fungi by lacto phenol cotton blue.

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MINOR PAPER

SUBJECT TITLE: CELL BIOLOGY (THEORY)
SUBJECT CODE: - BSMB-MN-102
SEMESTER – I, TOTAL HOURS: 60 CREDITS: 4 (Theory 3 Credits & Practical 1 credit)
Course Objectives:

The cell biology course objectives are:

1. Helping learners to describe cytological, biochemical & physiological aspects of cells.
2. Relate normal cellular structures to their functions.
3. Apply modern cellular techniques to solve aspects of scientific problems.

Total Number of Hrs. : 60		**Theory**	**Practical**	**Tutorial**
Credits		**3**	**1**	**-**
Hrs/Week		**3**	**2**	**-**
SCHEME OF EXAMINATION				
Total marks: 150				
Theory:100		**Practical:50**		
Final Exam (SEE)	**Internal Assessment (CT+TA)**	**Final Exam (SEE)**	**Internal Assessment (CT+TA/PR)**	
75	**25**	**37**	**13**	

Unit-1

Basics of Cell Biology (structure & function) – Discovery of cell and Cell Theory; Comparison between plant and animal cells; Cell wall; Plasma membrane; Modification of plasma membrane and intracellular junctions; (10 Hours)

Unit-2

Cytoskeleton; Protoplasm; Mitochondria; Chloroplast; ER; Golgi complex; Lysosome, endosome and micro bodies; Ribosome; Centriole; Nucleus; Chemical components of a cell; Catalysis and use of energy by cells. (10 Hours)

Unit-3

Biogenesis of Cellular organelles – Biosynthesis of mitochondria, chloroplast, ER, Golgi complex; Biosynthetic process in ER and Golgi apparatus; Protein synthesis and folding in the cytoplasm; Degradation of cellular components. (10 Hours)

Unit-4

Structure and function of Prokaryotic cell & its components - The Slime and the cell wall of bacteria containing peptidoglycan and related molecules; the outer membrane of Gram negative bacteria, the cytoplasmic membrane. Water and ion transport, mesosomes, flagella, Pilus, fimbriae, ribosomes, carboxysomes, sulphur granules, glycogen, polyphosphate bodies, fat bodies, gas vesicles; endospores, exospores, cysts. Mycelia of fungi and Actinomycetes, Cytoskeleton filament, heterocysts and akinets of Cyanobacteria, Gliding and motility. (10Hours)

Unit-5

Membrane structure & transport – Models of membrane structure, Membrane lipids, proteins and carbohydrates; Solute transport by Simple diffusion, Facilitated diffusion and Active transport.(10 Hours)

Unit-6

Cell cycle - An overview of cell cycle; Components of cell cycle control system; Intracellular and Extra-cellular control of cell division, Programmed cell death (Apoptosis), intrinsic & extrinsic pathways of cell death, Apoptosis in relation with Cancer, Viral disease (AIDS) & Organ transplant.(10 Hours)

BSMB-MN-102 -P Practical work

1. To study about the working principle ,parts and uses of a compound microscope
2. To study the different meiotic stages through permanent stained slides.
3. To study the different meiosis stages through permanent stained slides.
4. To prepare a stained temporary mount of onion peel.
5. To study and demonstration the process of mitosis through the preparation of the mount of an onion root tip.
6. To prepare a temporary mount of human cheek epithelial cells.
7. To study by demonstrating the osmosis process by potato osmometer.
8. To prepare a temporary mount of a leaf peel in order to show the stomata of a leaf.
9. To study the process of plasmolysis in epidermal cells of tradescantia leaf
10. To study and comment upon different organelles of a typical cell using specimens/photographs
11. To cut a transverse section of a given monocot stem and make a temporary stained mount to study its structure
12. To cut a transverse section of a given monocot stem and make a temporary stained mount to study its structure

13. To cut a transverse section of a monocot root of Maize and make a temporary stained mount to study its structure

14. To cut a transverse section of a given dicot stem and make a temporary stained mount to study its structure

Reference books:-

1. Alberts B, Bray D, Johnson A et al. (1997) Essential Cell Biology. London: Garland Publishing.
2. Darwin C (1859) On the Origin of Species. London: Murray.
3. Graur D & Li W-H (1999) Fundamentals of Molecular Evolution, 2nd edn. Sunderland, MA: Sinauer Associates.
4. Madigan MT, Martinko JM & Parker J (2000) Brock's Biology of Microorganisms, 9th edn. Englewood Cliffs, NJ: Prentice Hall.
5. Margulis L & Schwartz KV (1998) Five Kingdoms: An Illustrated Guide to the Phyla of Life on Earth, 3rd edn. New York: Freeman.
6. Watson JD, Hopkins NH, Roberts JW et al. (1987) Molecular Biology of the Gene, 4th edn. Menlo Park, CA: Benjamin-Cummings.

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Syllabus of B.Sc. Microbiology under NEP

INTERDISCIPLINARY PAPER

SUBJECT TITLE: CHEMICAL SCIENCE (THEORY)
SUBJECT CODE: - BSMB-ID-103
SEMESTER – I, TOTAL HOURS: 45 CREDITS: 3

Course Objectives:

1. To enable the students to understand about the Chemistry of Atomic and Molecular structure, Chemical Bonding, Chemistry of Bio inorganic molecules like Hemoglobin, Chlorophyll, and Vitamin B12.
2. To understand the Bio-Chemical relationship and properties of elements.
3. To enable the students to understand and apply the concepts of Concentration of Solutions, Colloidal behavior, Coagulation, pH in Bio-system, Food industry and in Medicine.
4. To enable the students to understand and apply the concepts of Rate of Reaction, Role of Enzyme Catalyst, Electro-Chemical behavior of body fluids, causes of corrosion in metals.
5. To enable the students to understand and apply the concepts of energy transfer through thermodynamics processes. Application in photosynthesis and global warming.

Total Number of Hrs. : 60		**Theory**	**Practical**	**Tutorial**
Credits		**2**	**1**	**-**
Hrs/Week		**2**	**2**	**-**
SCHEME OF EXAMINATION				
Total marks: 150				
Theory:100		**Practical:50**		
Final Exam (SEE)	**Internal Assessment (CT+TA+ Assignment)**	**Final Exam (SEE)**	**Internal Assessment (CT+TA/PR)**	
75	**25**	**37**	**13**	

Unit-1: Atomic Structure: Filling of electrons in orbitals. Chemical Bonding and Molecular Structure: Covalent bonding: VSEPR, VBT, hybridisation and MOT for homonuclear and heteronuclear (CO and HF) diatomic molecules. Ionic and Metallic bonding. Fajan's rule. Coordination bonding. Coordination structure of hemoglobin, chlorophyll, vitamin B12.

Unit -2: Modern Periodic Table: Modern Periodic law, Classification of elements in periodic table, periodicity, electronegativity, electron affinity, ionisation potential, atomic radii, ionic radii.

Unit-3: Solution: Definition, types and strengths. Indicators: definition, types and uses. Colloidal state: Definition, classification and applications in food and medicine. Acids and Bases: Arrhenius, Bronsted and Lowry theories and Lewis concept. Buffer solution and pH scale. Basic idea of determination of strength of unknown sample by titration method.

Unit-4: Chemical Kinetics: Order and molecularity of reaction, factors influencing rate of chemical reactions, first order chemical kinetics, half life period, Catalysis: definition, classification and characteristics. Enzyme catalysed reactions. Electrochemistry: work done and potential energy, galvanic cell and electrode potential. Corrosion: definition, cause and types of corrosion, metallic corrosion and their prevention.

Unit-5: Chemical Thermodynamics: First law of thermodynamics: Work (w), heat (q), changes in internal energy (ΔE) and enthalpy (ΔH). Concept of calorie and joule. Isothermal and adiabatic conditions for reversible and irreversible processes. Concept of standard state and standard enthalpies of formation (Kirchhoff''s equation). Second law of thermodynamics, Carnot's engine, concept of entropy, Gibbs free energy and Helmoltz free energy. Criteria of spontaneity

Reference Books:

1. J.D.Lee: A New Concise Inorganic Chemistry, E.L.B.S.
2. P.W. Atkins: Physical Chemistry, Oxford University Press
3. F. A. Cotton, G Wilkinson, PL. Gaus: Basic Inorganic Chemistry. Wiley
4. Physical Chemistry, RL Madan, G D Tuli: S Chand
5. Finar's Organic Chemistry

BSMB-ID-103-P: Chemical Science (Practical)

1. Introduction to calibration of analytical equipments and apparatus.
2. Determination of strength of given acid using titrimetric method with known Basic solution.
3. Determination of hydroxyl ions (alkalinity) in water sample.
4. Determination of calcium ion from aqueous solution by complexometric method.
5. Determination of pH of a solution using pH meter
6. Determination of surface tension of given liquid.
7. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture
8. Estimation of Fe (II) ions by titrating it with K2Cr2O7 using internal indicator
9. Determination of the relative and absolute viscosity of a liquid or dilute solution using an Ostwald's viscometer
10. Determination of concentration of Iron using Spectrophotometric method.

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Ability Enhancement Course (AEC)
Semester-1

Subject- Communicative English **Max. Marks**: 100
Subject Code-BSMB-AE-104

Evaluation Scheme

Credit	L	T	P	Semester End Examination	Internal Examination	Total
3	**3**	**0**	**0**	**75**	**25**	**100**

Course Objectives

1- Understand and apply the fundamentals of English grammar and vocabulary in everyday communication.
2- Develop the ability to comprehend spoken and written English through focused listening and reading exercises.
3- Improve writing skills for basic functional and personal communication, including sentence and paragraph formation.
4- Enhance speaking skills for social, academic, and workplace interactions.

Course Outcomes

After completing the course, students will be able to:

1. Construct grammatically correct sentences using appropriate vocabulary.
2. Read and understand short texts, instructions, and messages in English.
3. Listen and respond appropriately to spoken English in various everyday contexts.
4. Write simple emails, notes, messages, and personal narratives clearly and coherently.
5. Speak confidently and clearly in common social and functional situations, including introductions, questions, and conversations.

Unit 1: Fundamentals of English Grammar and Vocabulary Building

Parts of Speech, Articles, Modals
Subject-verb agreement, Tenses
Direct and Indirect Speech
Synonyms, Antonyms, Homophones and Homonyms
Error Correction

Unit 2: Reading Skills

Reading comprehension (Skimming and Scanning)
Reading Academic Texts
Identifying the main idea of the text
Prescribed Text: Short Story 'Out of Business' by R.K Narayan

Unit 3: Listening Skills

Types of Listening,
Listening vs. Hearing
Listening for the main idea,
Note-Taking strategies

Unit 4: **Speaking Skills**
Phonetics and Pronunciation (Syllable, Stress and Intonation)
Everyday Conversation and dialogue practice,
Extempore
Descriptive and Narrative Speaking,
Oral Presentation

Unit 5: Writing Skills
Paragraph writing,
Structuring essays,
Writing Formal and Informal letters,
Article writing
Email writing

Suggested Readings:
Adair, John. *Effective Communication*. Revised ed., Pan Macmillan, 2003.
Clark, John, and Colin Yallop. An Introduction to Phonetics and Phonology. 4th ed., Wiley Blackwell, 2016.
Murphy, Raymond. English Grammar in Use: A Self-Study Reference and Practice Book for Intermediate Learners of English. 5th ed., Cambridge University Press, 2019.
McCarthy, Michael, and Felicity O'Dell. *Basic Vocabulary in Use*. Cambridge University Press, 2001.
Seely, John. *The Oxford Guide to Writing and Speaking*. 2nd ed., Oxford University Press, 2005.

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SEC PAPER

SUBJECT TITLE: ENVIRONMENT AND ECOLOGY (THEORY)
SUBJECT CODE: - BSMB SE-105
SEMESTER – I, TOTAL HOURS: 45 CREDITS: 3

Course Objectives:

1. Investigate the complexities of the natural environment and our relationship with it.
2. Explore the problems we face in understanding our natural environment and in living sustainably.
3. Develop scientific, interpretive, and creative thinking skills.

Total Number of Hrs.: 45		**Theory**	**Practical**	**Tutorial**
Credits		2	1	-
Hrs/Week		2	2	-
SCHEME OF EXAMINATION				
Total marks: 100				
Theory: 100		**Practical: 50**		
Final Exam (SEE)	**Internal Assessment (CT+TA)**	**Final Exam (SEE)**	**Internal Assessment (CT+TA/PR)**	
75	**25**	**37**	**13**	

Unit-1 Basic Understanding (8 Lectures)

Introduction of Environment, Categories of Environment, Features of Environment, Components of Environment, Ecology, Ecosystem and Its Dynamics, Ecosystem Dynamics, Terrestrial Ecosystem, Aquatic Ecosystem, Changes in Ecosystem, Ecosystem Conservation, Biogeochemical Cycles, Gaseous Cycle, Carbon Cycle, Effects of High Concentration of Greenhouse Gases, Hydrological Cycle, Nitrogen Cycle, Oxygen Cycle, Sedimentary Cycle, Sulphur Cycle, Phosphorus Cycle

Unit-2 Natural Resources, Biosphere & Biomes (8 Lectures)

Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people, Water resources: Use and over-utilization of surface and

ground water, floods, drought, conflicts over water, dams-benefits and problems, Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies, Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies, The extent of the Biosphere, Working of the Biosphere, Importance of the Biosphere, Biosphere of India and Uttarakhand, Biomes, Global Biomes, Major Biomes of the World

Unit-3 Biodiversity & Conservation (8 Lectures)

Types of Biodiversity, Value of the Biodiversity, Threats to Biodiversity, Alpha, Beta, Gamma Diversity Causes of Biodiversity losses, Invasive species, Exotic species, Effects of Loss of Bio-Diversity, Conservation Strategies, IUCN, IUCN Red List, Ecologically Sensitive Area (ESAs), In-situ methods of conservation of biodiversity, Advantages of In-situ Conservation, Disadvantages of In-situ conservation, Ex-situ Methods of Conservation of Biodiversity, Biodiversity Act 2002

Unit-4 Environmental Pollution & Policies (8 Lectures)

Water Degradation, Measurement of Water Pollution, Harmful Effects of Water Pollution, Sewage Treatment Technology and Policies, Eutrophication, Air Pollution, Causes of Air Pollution, Harmful Effects of Common Air Pollutants, Control of Air Pollution, Environmental Protection Act 1986, Waste Management, Solid Waste Management, Salient features of SWM Rules, 2016, Bio-Medical Waste Management Rules, 2016

Unit-5 Climate Change, Environmental Impact Assessment & Disaster (8 Lectures)

Impact of climate change & its mitigation, Climate Change Management, Conventions, International Organisations, Role of India to minimise the carbon foot prints, Impact of Agriculture on Environment, Sustainable Agriculture, Hi-tech Farming Methods, Rain Water Harvesting, Green Buildings and their Rating System in India, Disaster and their composition, Disaster Management Techniques, Common Wealth Government Plan for Disaster Management, Case Studies

1. **Educational tour : (**Two in Semester) visit to Industries, Research Organisations, Protected Areas Educational tours are important for environmental science because they help students learn about the environment and how to care for it. They also help students develop a sense of responsibility and empathy towards the world around them. (***One tour is equable to 02 Lectures***)

2. **Environment & Ecology based documentary Screening**: (Two in semester) **equable to 02 Lectures**

Recommended Books:

- Essential Environmental Studies by S P Misra & S. N Pandey (Anr Books Pvt. Ltd.)
- Environmental Studies by J P Sharma, Laxmi Publications,
- Paryavaran Addhayan (Hindi version) by Anubha Kaushik & C P Kaushik, New Age Publications
- Ecology & Environmental Biology by Ramdeo Misra, English Book Depot
- Environment and Ecology by R.Rajagopalan, OAK BRIDGE
- Ecology by Dr. Kailash Chaudhary & Dr. Ram Prakash Saran, IFAS Publications
- Fundamentals of Ecology by Eugene Pleasants Odum, CENGAGE Learning

Practical in Environment & Ecology BSMB SE-105-P

1. Soil Testing: Texture, Moisture, pH, Nitrate, Phosphate, Sulphate, Quadrats Methods.
2. Instrumentation: Secchi Disk, Atmometer, Anemometer, Hygrometer, Luxmeter
3. Water Testing: Hardness, BOD, COD, DO, TDS
4. Common and threatened Plants and Animals spotting
5. Detailed report presentation on educational tour by the students

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COURSE DETAILS
SUBJECT TITLE: FOUNDATION OF YOGA (THEORY)
SUBJECT CODE: - BSMB-VA-106
SEMESTER-I TOTAL HOURS: 30 CREDITS: 2

Course Objectives:

Course Outcome:

1. Students of the UG course will have an understanding of Yoga, its origin, history and development of Yoga
2. It will encourage the students to live life with discipline, honesty, kindness and integrity in order to find their purpose and to live it fully.

Total Number of Hrs. : 30		**Theory**	**Practical**	**Tutorial**
Credits		**2**	**-**	**-**
Hrs/Week		**2**	**-**	**-**
SCHEME OF EXAMINATION				
Total marks: 100				
Theory:100		**Practical:00**		
Final Exam (SEE)	**Internal Assessment (CT+TA)**	**Final Exam (SEE)**		**Internal Assessment (CT+TA/PR)**
75	**25**	**00**		**00**

UNIT-1: GENERAL INTRODUCTION TO YOGA

Brief about origin of Yoga: Psychological aspects of Yoga, History and Development of Yoga: prior to the Vedic period, Vedic period, Medival period, modern era; Etymology and Definitions of Yoga, Aims and Objectives of Yoga, Misconceptions about Yoga; Importance of Yoga. (10 Hours)

UNIT-2: DIFFERENT STREAMS OF YOGA

Jnana Yoga: Meaning of Jnana and Jnana-Yoga, Sadhana-chatushtaya, Means of Jñāna, Bhakti Yoga: Meaning of Bhakti and Bhakti-Yoga, Stages of Bhakti, Types of Bhakti,Means of Bhakti-Yoga; Karma Yoga: Meaning of Karma and Karma-Yoga, Concept of Nishkama Karma, Means of Karma Yoga; Inter-relationship between Bhakti Yoga, Karma-Yoga and Jnana Yoga. (8 Hours)

UNIT - 3: BRIEF ABOUT YOGA IN TEXTS

Brief of Yoga in Vedas and Yoga in Principal Upanishads, Yogic perspective: Bhagavad Gita, Yoga Vasishtha, Narada Bhakti Sutras. Yogic perspective: Puranas with emphasis to Bhagavat Purana; Emphasis to Vedantic approach of Shankaracharya, Ramanujacharya, Madhvacharya and Vallabhacharya.

UNIT-4: INTRODUCTION TO EMINENT YOGIS

Introduction to eminent Yogis and their style of Yoga: Hiranyagarbha, Vyasa, Kapilmuni, Bhrtrihari, Adishankaracharaya, Maharshi Dayanand, Swami Vivekanand, Maharshi Arvind, Swami Kuvalyanand,Swami Shivanand, Yogrishi Swami Ramdev. (5 Hour)

TEXT BOOKS

- Yogrishi Swami Ramdev Ji : Yog ke moolbhut Sidhhant, Divya Prakashan, Haridwar.
- Acharya Balkrishna: Grihasth Yog Sadhak k Gun, Divya Prakashan, Haridwar, 2017.
- Singh S P & Yogi Mukesh: Foundations of Yoga, Standered Publication, New Delhi, 2010.
- Yogendra Purusharthi (Sw. Divyananda Saraswati): Vedo me Yog Vidya, Yogic Sodhsansthan, 1985.
- Yogrishi Swami Ramdev Ji: Ek Yogi Ek Yodhha, Divya Prakashan, Haridwar, 2015.
- Sri Vishwanath Mukharji: Bharat ke Mahan Yogi, Vishvavidyalaya Prakashan, 2012.

BOOKS FOR REFERENCE

- Acharya Balkrishna: Yog Vishwakosh, Divya Prakashan, 2014.
- Agarwal M M: Six systems of Indian Philosophy, Chowkhambha Vidya Bhawan, varanai, 2010.
- Swami Bhuteshananda: Nararad Bhakti Sutra, Advaita Ashrama Publication-Dept. Kolkata, II Edition, 2009
- Radhakrishnan S: Indian Philosophy, Oxford University, UK (Vol. I & II) II Edition, 2008
- Max Muller K. M: The six systems of Indian Philosophy, Chukhambha, Sanskrit series, Varanasi, 6th Edition, 2008
- Paul Brunton: A search in secret India, Riders Books, 2003

2ND SEMESTER

University of Patanjali, Haridwar
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Core Course
COURSE DETAILS
SUBJECT TITLE: BACTERIOLOGY & VIROLOGY (THEORY)
SUBJECT CODE: - BSMB-MJ-201
SEMESTER – II TOTAL HOURS: 60 CREDITS: 6

Course Objectives:

The Bacteriology course objectives are

1. Helping learners to describe cytological, biochemical, physiological aspect of cell.
2. Relate normal cellular structures to their functions.
3. Apply modern cellular techniques to solve aspects of scientific problems.

Course Outcome:

1. Describe characteristics of bacterial cells, cell organelles, cell wall composition and various appendages like capsules, flagella or pili.
2. Differentiate a large number of common bacteria by their salient characteristics; classify bacteria into groups.
3. Describe the nutritional requirements of bacteria for growth; developed knowledge and understanding that besides common bacteria there are several other microbes which grow under extreme environments.
4. Perform basic laboratory experiments to study microorganisms; methods to preserve bacteria in the laboratory; calculate generation time of growing bacteria

Total Number of Hrs. : 60		**Theory**	**Practical**	**Tutorial**
Credits		**5**	**1**	**-**
Hrs/Week		**5**	**2**	**-**
SCHEME OF EXAMINATION				
Total marks: 150				
Theory:100		**Practical:50**		
Final Exam (SEE)	**Internal Assessment (CT+TA)**	**Final Exam (SEE)**	**Internal Assessment (CT+TA/PR)**	
75	**25**	**37**	**13**	

Unit 1 Cell organization and nutrition No. of Hours: 10

Cell-wall: Composition and detailed structure of gram positive and gram-negative cell walls, Archaebacterial cell wall.Cell Membrane: Structure, function and chemical composition of bacterial and archaeal cell membranes. Nutritional requirements in bacteria and nutritional categories; Culture media: components of media, natural and synthetic media, chemically defined media, complex media, selective, differential, indicator, enriched and enrichment media Physical methods

of microbial control: heat, low temperature, high pressure, filtration, desiccation, osmotic pressure, radiation Chemical methods of microbial control: disinfectants, types and mode of action

Unit 2 Bacteriological techniques and reproduction of bacteria No. of Hours: 10

Pure culture isolation: Streaking, serial dilution and plating methods; cultivation, maintenance and preservation/stocking of pure cultures; cultivation of anaerobic bacteria, and accessing non-culturable bacteria. Asexual methods of reproduction, logarithmic representation of bacterial populations, phases of growth, calculation of generation time and specific growth rate

Unit 3 Important archaeal and eubacterial groups No. of Hours: 10

Archaebacteria: General characteristics, phylogenetic overview, genera belonging to Nanoarchaeota (Nanoarchaeum), Crenarchaeota (Sulfolobus, Thermoproteus) and Euryarchaeota [Methanogens (Methanobacterium, Methanocaldococcus), thermophiles (Thermococcus, Pyro coccus, Thermoplasma), and Halophiles (Halo bacterium, Halo coccus)] Eubacteria: Morphology, metabolism, ecological significance and economic importance of following groups: Gram Negative: Non proteobacteria: General characteristics with suitable examples

Unit 4 Nature and Properties of Viruses & Bacteriophages No. of Hours: 10

Introduction: Discovery of viruses, nature and definition of viruses, general properties, concept of viroids, virusoids, satellite viruses and Prions. Theories of viral origin Structure of Viruses: Capsid symmetry, enveloped and non-enveloped viruses Isolation, purification and cultivation of viruses Viral taxonomy: Classification and nomenclature of different groups of viruses. Diversity, classification, one-step multiplication curve, lytic and lysogenic phages (lambda phage) concept of early and late proteins, regulation of transcription in lambda phage

Unit 5 Viral Transmission, Salient features of viral nucleic acids and Replication

No. of Hours: 10

Modes of viral transmission: Persistent, non-persistent, vertical and horizontal. Salient features of viral Nucleic acid: Unusual bases (TMV, T4 phage), overlapping genes (ϕX174. Hepatitis B virus), alternate splicing (HIV), terminal redundancy (T4 phage), terminal cohesive ends (lambda phage), partial double stranded genomes (Hepatitis B). long terminal repeats (retrovirus), segmented (Influenza virus), and non-segmented genomes (picornavirus), capping and tailing (TMV) Viral multiplication and replication strategies. Interaction of viruses with cellular receptors and entry of viruses. Replication strategies of viruses as per Baltimore classification (phi X 174, Retroviridae, Vaccinia, Picorna), Assembly, maturation and release of virion

Unit 6 oncogenes, Antiviral therapy No. of Hours: 10

Introduction to oncogenic viruses Types of oncogenic DNA and RNA viruses: Concepts of oncogenes and proto-oncogenes. Antiviral compounds and their mode of action Interferon and their mode of action General principles of viral vaccination. Use of viral vectors in cloning and expression, Gene therapy and Phage display.

BSMB-MJ-201-P BACTERIOLOGY & VIROLOGY (PRACTICAL)

Duration: 30 CREDITS: 1

1. Preparation of different media
2. Simple staining, Negative staining, Gram's staining
3. Staining of fungi by Lacto phenol cotton blue

4. Isolation of pure cultures of bacteria by streaking method.
5. Preservation of bacterial cultures by various techniques.
6. Estimation of CFU count by spread plate method/pour plate method.
7. Study of the structure of important animal viruses (Rhabdo, influenza, paramyxo hepatitis B and retroviruses) using electron micrographs
8. Study of the structure of important plant viruses (caulimo, Gemini, tobacco ring spot, cucumber mosaic and alpha-alpha mosaic viruses) using electron micrographs
9. Study of the structure of important bacterial viruses (ϕX 174, T4, λ) using electron micrograph.
10. Isolation and enumeration of bacteriophages (PFU) from water/sewage sample using double agar layer technique
11. Studying isolation and propagation of animal viruses by chick embryo technique
12. Study of cytopathic effects of viruses using photographs
13. Perform local lesion technique for assaying plant viruses.

Suggested Readings

1. Black JG. (2015). Microbiology: Principles and Explorations. 9th edition. Prentice Hall.
2. Prescott, Harley, Klein's Microbiology, J.M. Willey, L.M. Sherwood, C.J. Woolverton, 12th edition 2023, McGraw Hill.
3. A Textbook of Microbiology, R. C. Dubey and D. K. Maheshwari, 4th edition, 2013, S. Chand & Company Ltd.
4. Microbiology- Concepts and Applications, Pelczar Jr,Chan, Krieg, International 6th ed, McGraw Hill.
5. Dimmock, NJ, Easton, AL, Leppard, KN (2016). Introduction to Modern Virology. 7th edition, Blackwell Publishing Ltd.
6. Carter J and Saunders V (2013). Virology: Principles and Applications. John Wiley and Sons. 2nd Ed.

University of Patanjali, Haridwar

Syllabus of B.Sc. Microbiology under NEP

SUBJECT TITLE: BIOPHYSICS (THEORY)
SUBJECT CODE: - BSMB-MN-202
SEMESTER – II, TOTAL HOURS: 60 CREDITS: 4

Course Objectives: The biophysics course objectives are

1. It Helps learners to understand the laws of physics to biological problems.
2. Biophysics helps to understand the various laws & principles used for biological systems.

Total Number of Hrs.: 45	**Theory**	**Practical**	**Tutorial**
Credits	4	0	-
Hrs/Week	4	0	-
SCHEME OF EXAMINATION			
Total marks: 100			
Theory:100		**Practical:00**	
Final Exam (SEE)	**Internal Assessment (CT+TA)**	**Final Exam (SEE)**	**Internal Assessment (CT+TA/PR)**
75	**25**	**00**	**00**

Unit1: General Physics: [15 Hrs.]

Conservation of momentum and energy, work energy theorem. Angular momentum, Physiological effects of acceleration and angular motion. Simple harmonic motion, Wave equation, superposition principle, interference, effects of vibrations in humans.

Unit 2: Cell, Protein Structure & Stability [15 Hrs.]

Cell structure and mechanics, Elasticity and its types, Cell signaling, Cell Cycle and growth, Cell interaction, Viscometry Predicting properties of proteins from amino acid composition. Primary structure sequencing of polypeptide, hemoglobin, homologies in proteins, Secondary structure alpha and beta conformation, collagen structure, stability of alpha helix, Ramachandran plot, Tertiary structure, structure of myoglobin and hemoglobin, Quaternary structure, Analysis of subunits and chain arrangement of subunits, stability of globular quaternary structure. Protein folding rules.

Unit 3: Biophysics of Various Organs [20 Hrs.]

(i) Structure of the eye, Optics of Vision, retinal pigments, rods and cones, Photochemistry of vision, structure of ear, physics of audition (amplitude, frequency, pitch), unit of

measurement of sound, intensity, Audiometry, deafness, hearing aids. Taste & Smells: taste receptors & their role

(ii) Electrocardiogram (ECG) and its characteristics, structure of lungs, diffusion, exchange and transport of gases, Effect of altitude changes on body, high altitude- mountain sickness. Biophysics of nerves, generation and propagation of nerve impulse, synapse, synaptic transmission, Brain Waves (EEG): origin of alpha, beta, delta & theta waves.

Unit4: [10 hrs.]

Algebra, Matrices, Determinants, Differentiations, Integrations.

Suggested Readings:

1. Physical Biochemistry, David Frei elder, Applications to Biochemistry and Molecular Biology, 2nd Edition, W.H. Freeman and Company, 2005.
2. Hoppe et. al., Biophysics, Translation of 2nd German Edition, Springer Verlag, 1983.
3. Keith Wilson and John Walker, Principles and Techniques of Biochemistry and Molecular Biology, 6th Edition, Cambridge University Press, 2005

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University of Patanjali, Haridwar

Syllabus of B.Sc. Microbiology under NEP

SUBJECT TITLE: COMPUTER APPLICATION (THEORY)
SUBJECT CODE: - BSMB-ID-203
SEMESTER – II, TOTAL HOURS: 45 CREDITS: 4

Course Objectives:

1. To understand the basic concept of Computer Programming.

2. To understand various aspects of Biology and Computer Programming techniques.

Course Outcome:

1. This is a skill based paper that introduces the students to the basics of computer operations The student is imparted with knowledge on both hardware and software.
2. The student has a better understanding on the use of computers for various applications

Total Number of Hrs. : 30		**Theory**	**Practical**	**Tutorial**
Credits		**3**	**1**	**-**
Hrs/Week		**3**	**2**	**-**
SCHEME OF EXAMINATION				
Total marks: 100				
Theory:100		**Practical: 50**		
Final Exam (SEE)	**Internal Assessment (CT+TA)**	**Final Exam (SEE)**	**Internal Assessment (CT+TA/PR)**	
75	**25**	**37**	**13**	

COMPUTER PROGRAMMING FOR BIOLOGISTS

Fundamentals of computers, algorithms, computer basics, Constants, variables, bits, bytes, binary and ASCII formats, arithmetic expressions, hierarchy of operations, inbuilt functions. Elements of the BASIC language. BASIC keywords and commands. Logical and relative operators. Strings and graphics. Compiled versus interpreted languages. Debugging. Simple programs using these concepts, AI and Generative AI, Its applications.

Simple programming in Python: Getting started with Python program

Variables, keywords and Operators, Control flow statements, Numbers and Functions, Strings, Lists, Tuples, Dictionary and Sets, More of Python functions, Object oriented programming with Python, Exception Handling in Python, File handing, Regular expression, Multithreading, Database, Python Debugging and Automation, Usage of standard module and web-scrapping.

Books Recommended:

1. Venit, S.M. Programming in BASIC: Problem solving with structure and style. Jaico Publishing House: Delhi (1996).
2. Let us Python by Kanetkar, BPB Publication, Noida.

SUBJECT TITLE: COMPUTER APPLICATION (PRACTICAL)
SUBJECT CODE: - BSMB-ID-203-P CREDITS: 1 TOTAL HOURS: 30

a. To calculate perimeter/ circumference and area of shapes such as triangle, rectangle, square and circle
b. To find largest and smallest numbers in a list
c. To find the sum of squares of the first 100 natural numbers
d. Create a dictionary to store names of states and their capitals
e. To find average and grade for given marks
f. To print the highest and lowest values in the dictionary
g. Create a dictionary of students to store names and marks obtained in 5 subjects

University of Patanjali, Haridwar

Syllabus of B.Sc. Biological Sciences under NEP

Ability Enhancement Course (AEC)
Semester-2

Subject- Advanced Communicative English Max. Marks: 100
Subject Code-BSMB-AE-204

Evaluation Scheme

Credit	L	T	P	Semester End Examination	Internal Examination	Total
3	3	0	0	75	25	100

Course Objectives:

1. Enhance vocabulary through prefixes, suffixes, idioms, and phrasal verbs.
2. Develop critical reading and text analysis skills.
3. Improve public speaking, debating, and interview techniques.
4. Strengthen academic and professional writing skills.
5. Build confidence in formal communication settings.

Course Outcomes:

After completing the course, students will be able to:

1. Use advanced vocabulary appropriately in context.
2. Analyze and interpret academic and professional texts.
3. Speak fluently and confidently in various formal settings.
4. Write structured essays, reports, and business documents.
5. Perform effectively in group discussions and interviews.

Unit 1: Vocabulary expansion

Suffixes and Prefixes, Phrasal Verbs, Idioms and Collocations,
Learning words in context (academic, professional and social)

Unit 2: Reading Comprehension and Analysis

Strategies to read Academic and Professional Texts
Critical reading (Analysis and Interpretation)
Vocabulary in context
Prescribed Texts: An excerpt titled 'The Boat' from the book *My Journey: Transforming Dreams into Actions* by A.P.J Abdul Kalam

'Peace- A Poem by Swami Vivekananda'

Unit 3: Advanced Speaking Skills

- Public Speaking
  Preparing speeches and presentation
  Techniques for effective public speaking (body language, eye contact and voice modulation)
- Debate and Group Discussion
  Strategies for formal debates
  Critical thinking and analytical skills
  Leadership and teamwork in group discussion,
- Interview Skills

Different types of interviews
Identifying your strengths, weaknesses, skills and achievements,
Prepare answers to typical interview questions
Understanding body language and other non-verbal ques,

Unit 4: Academic and Professional Writing

- Essay writing
  Structure of academic essays
  Developing arguments
- Academic writing
  Conventions of Academic writing
  Summarizing and Paraphrasing
- Business writing
  Writing formal emails and reports
  Creating professional documents (resume, CVs and cover letter)
  Writing business letters
- Technical writing
  Research paper and abstract writing
  Documentation and user manuals
  Data interpretation and presentation (charts, graphs, tables)

Suggested Readings

Eastwood, John. Oxford Guide to English Grammar. Oxford University Press, 1994. Hewings, Martin.
Butterfield, Jeff. *Soft Skills for Everyone*. 2nd ed., Cengage Learning India, 2020.
Burnett, Ann, and Pamela Stephens. Group Discussion: A Practical Guide to Participation and Leadership. 4th ed., Allyn & Bacon, 2000.
McCarthy, Michael, and Felicity O'Dell. English Vocabulary in Use: Advanced. Cambridge University Press, 2008.
Paul, Richard, and Linda Elder. Critical Thinking: Tools for Taking Charge of Your Learning and Your Life. 4th ed., Pearson, 2021.

University of Patanjali, Haridwar

Syllabus of B.Sc. Microbiology under NEP

Subject: Medicinal Plants

SUBJECT CODE: BSMB-SE-205

SEMESTER-II: TOTAL HOURS: 60

Credit 3 (Theory 2 and Practical 1 Credit)

Course Objectives:

1. To make the students aware of the novel properties of medicinal plants.
2. To make the students expert in identifying the medicinal plants available in their locality, irrespective of the field to which he/she belongs.
3. To learn to identify the most common and useful medicinal plants

Total Number of Hrs. : 60		**Theory**	**Practical**	**Tutorial**
Credits		**2**	**1**	**-**
HRs/Week		**2**	**2**	**-**
SCHEME OF EXAMINATION				
Total marks: 150				
Theory:100		**Practical:50**		
Final Exam (SEE)	**Internal Assessment (CT+TA)**	**Final Exam (SEE)**	**Internal Assessment (CT+TA/PR)**	
75	**25**	**37**	**13**	

Unit 1: Diversity and Geographical Distribution of Medicinal Plants in India; Taxonomic identification of Medicinal Plants; Drug Adulteration and Substitutions; Conservation Status of Medicinal Plants in India.

Unit 2: Detail study like botanical name, family name, common names, plant parts used, botanical description, chemical constituents, medicinal uses, contraindication, adverse effect of some important medicinal plants obtained from different plant sources like

Root/Rhizome Sources: Acorus (Vach), Ashwagandha, Ginger (Adrak), Jatamansi, Indian Snakeroot (Sarpagandha), Satawar, Turmeric (Haldi)

Oil Sources: Castor (Erand), Chaulmoogra, Mustard (Sarson), Sesame (Til)

Bark/Stem Sources: Arjuna, Ashoka, Cinnamon (Dalachini), Giloy, Kutaj

Gum and Resin Sources: Gum Arabic (Babool), Guar gum, Guggul, Gum Sterculia, Tragacanth

Leaf Sources: Aloe vera, Curry Leaves, Kalmegh, Mint (Pudina), Margosa (Neem), Cinnamon Leaves (Tejpatra), Holy Basil (Tulsi), Vasaka

Fruit/Seed Sources: Indian Gooseberry (Amla), Bahera, Black pepper (Kali Mirch), Cardamom (Elaichi), Clove, Coriander (Dhania), Fennel, Fenugreek (Methika, Methi), Harad, Wood Apple (Indian Bael), Indian Screw Tree (Marod Phali), Shikakai, Timbru

Unit 3: Study of some rare and highly prized medicinal plant of India like Keeda Jadi, Morchella, Salam Punja

Practical (BSMB-SE-205-P)

1. Morphological examinations, botanical name, family, parts used and uses of some important medicinal plants like Aloe vera, Amla, Arjuna, Ashwagandha, Babool, Bahera, Black pepper, Cardamom, Cinnamon (Dalachini), Giloy, Clove, Curry Leaves, Ginger, Harad, Indian Screw Tree, Sarson, Satawar, Tejpatra, Tulsi, Turmeric, Vasaka

2. Preparation and submission of herbarium sheets of 10 medicinal plants

Suggested Reading:

1. Acharya Balkrishna: Ayurveda Jadi Booti Rahasya

2. B.K.Verma: Introduction to Taxonomy of Angiosperms

3. C.P. Khare: Indian Medicinal Plants: An Illustrated Dictionary

4. S.S. Handa & V.K. Kapoor: Textbook of Pharmacognosy

University of Patanjali, Haridwar

Syllabus of B.Sc. Microbiology under NEP

COURSE DETAILS
SUBJECT TITLE: SANSKAR (THEORY)
SUBJECT CODE: - BSMB-VA-206
SEMESTER – II TOTAL HOURS: 30 CREDITS: 2
Course Objectives:

Course Outcome:

Total Number of Hrs. : 30		**Theory**	**Practical**	**Tutorial**
Credits		**2**	**-**	**-**
Hrs/Week		**2**	**-**	**-**
SCHEME OF EXAMINATION				
Total marks: 100				
Theory:100		**Practical:00**		
Final Exam (SEE)	**Internal Assessment (CT+TA)**	**Final Exam (SEE)**	**Internal Assessment (CT+TA/PR)**	
75	**25**	**00**	**00**	

Unit I:

Varna-Ashrama System Origin and development of Varna Vyavastha
Origin, development and significance of Ashrama Jati Vyavastha

Unit II:

Marriage and Family Meaning and objectives of marriages
Types of marriages Concept and component of family

Unit III:

Position and Role of Women Position and status of women in Ancient society
Stree Dhan and her Property rights

Unit IV:

Purusharth and Sanskaras
Types of Purushartha
Types of Sanskaras

Unit V:

Education System Objectives of education
Important centers of education: Nalanda, Balabhi, Kashi and Taxila

Text Book: Mishra, J.S., Prachin Bharat ka Samajik Itihas, Patna, 1986

Recommended Readings:

1- Altekar, A. S., Education in Ancient India (Also in Hindi) Altekar, A.S., Position of Women in Hindu Civilization,

2- Dutt, N. K., Origin and Growth of Caste in India, Calcutta, 1931.

3- Jauhari, M., Prachin Bharata Mem VarnasramaVyavastha (Hindi), Varanasi, 1985.

4- Kapadia, K. M., Marriage and Family in India (English)

Tripathi, L.K. (ed.), Position and Status of Women in Ancient India, 2 Vols., Varanasi, 1988 and 1992

3RD SEMESTER

University of Patanjali, Haridwar

Syllabus of B.Sc. Microbiology under NEP

Core Course

COURSE DETAILS

SUBJECT TITLE: Medical Parasitology and Mycology

SUBJECT CODE: - BSMB-MJ-301

SEMESTER – III

CREDITS: 5+1

Course Objectives:

1. To learn the basics of parasitology and mycology
2. To understand about the types of medically important parasites and fungus.
3. To Study the mechanisms and treatment method
4. To know about the diagnosis of the parasites and fungus

Course Outcomes:

CO1: Thorough knowledge and understanding of concepts of mycology and parasitology.

CO2: Learning and practicing professional skills in handling microbes.

CO3: Thorough knowledge and application of good laboratory skills to diagnose diseases.

	Theory	Practical	Tutorial
Credits	**5**	**1**	**-**
Hrs/Week	**5**	**2**	**-**
SCHEME OF EXAMINATION			
Total marks: 150			
Theory:100		**Practical:50**	
Final Exam (SEE)	**Internal Assessment (CT+TA)**	**Final Exam (SEE)**	**Internal Assessment (CT+TA/PR)**
75	**25**	**37**	**13**

Unit-1 **10 hrs**

Morphology, Taxonomy, Classification of fungi. Characteristics of Zygomycetes, Ascomycetes, Basidiomycetes and Duteromycetes.

Unit-2 **15 hrs**

Dermatophytes and agents of superficial mycoses. Trichophyton, Epidermophyton and Microsporum. Opportunistic mycoses Candidiasis, Cryptococcosis, Aspergillosis. Systemic mycoses. Histoplasmosis, Coccidioidomycosis, Blastomycosis. Subcutaneous mycoses-Sporotrichosis, Mycetoma

Unit-3 **10 hrs**

Collection, transport of specimens, isolation of fungi from clinical specimens. Newer methods in diagnostic mycology. Mycotoxins, Antifungal agents, testing methods and quality control.

Unit-4 **10 hrs**

Introduction to medical Parasitology – Classification, Protozoa – Entameoba – Plasmodium, Leishmania – Trypanosoma –Giardia – Trichomonas – Balantidium.

Unit-5 **15 hrs**

Platyhelminthes – Taenia – Fasciola – Paragonimus – Schistosoma. Nematihelminthes – Ascaris – Ankylostoma – Enterobius – Trichuris – Trichinella – Wuchereria – Dracanculus. Laboratory techniques in parasitology. Examination of faeces for ova and cysts – Concentration methods. Blood smear examination for parasites. Cultivation of protozoan parasites.

BSMB-MJ-301-P- Medical Parasitology and Mycology (PRACTICAL)

1. KOH and Lactophenol preparations for skin scrapings for dermatophytes.
2. Microscopic identification and cultural characteristics of medically important fungi and lab contaminants.
3. Germ tube, carbohydrate assimilation and fermentation tests for yeasts.
4. Direct examination of faeces- wet mount and Lugol's iodine method
5. Demonstration of protozoan cysts and helminthes eggs.
6. Concentration techniques of stool specimen- floatation and sedimentation methods. Examination of blood for malarial parasites thin and thick smear preparation.
7. Identification of pathogenic parasites in slides/ specimens as spotters.

Suggested Reading:

1. Alexopoulus CJ and C W. Mims.(1993).Introductory Mycology (3rd edition) WileyEastern Ltd, New Delhi.

2. Elizabeth Moore-Landecker. (1996). Fundamentals of the fungi.(4th edition). Prentice Hall International, Inc, London

3. Jewetz, E., Melnic, J.L. and Adelberg, E.A. (2000) Review of Medical Microbiology, 19th Edn. Lange Medical Publications, U.S.A.

4. Ananthanarayan, R. and Jeyaram Paniker, C.K. (1994) Text Book of Microbiology, 6th Edn. Orient Longman, Chennai.

5. Jeyaram Paniker, C.K. (2006) Text Book of Parasitology. Jay Pee Brothers, New Delhi.

6. Alexopolus, C.J. and Mims, C.W. (1979) Introductory Mycology, 3 rd Edn .John Wiley and Sons, New York.

7. Schmidt, G.D. and Roberts, L.S. (1981) Foundations of Parasitology, 2nd Edn, Mosby, St. Louis.

8. Finegold, S.M. (2000) Diagnostic Microbiology, 10th Edn. C.V. Mosby Company, St. Louis 9. Jagadish Chander (1996) A Text Book of Medical Mycology. Interprint, New Delhi.

10. Arora, D.R. and Arora, B.(2002) Medical Parasitology, 1st Edn CBS Publishers & Distributors, New Delhi.

11. Walter Beck, J. and Davies, J.E.(1976) Medical Parasitology, 2nd Edn. C.V. Mosby Company, St. Louis.

12. Robert Desowitz (1980) Ova and Parasites. Harper and Row Publishers, New York.

13. Levanthal, R. and Cheadle, R.S. (1979) Medical Parasitology. S.A. Davies Co., Philadelphia.

14. Chatterjee (1986) Medical Parasitology. Tata McGraw Hill, Calcutta.

University of Patanjali, Haridwar

Syllabus of B.Sc. Microbiology under NEP

SUBJECT TITLE: BASICS OF IMMUNOLOGY (THEORY)
SUBJECT CODE: - BSMB-MN-302
SEMESTER – III, TOTAL HOURS: 60 CREDITS: 4
Course Objectives:

1. To teach students immune system and its components, the defence mechanisms that can establish a state of immunity against infection, and Immune-related diseases.
2. To provide knowledge on immune deficiencies and several immunological techniques.

Total Number of Hrs.: 60		**Theory**	**Practical**	**Tutorial**
Credits		3	1	-
Hrs/Week		3	2	-
SCHEME OF EXAMINATION				
Total marks: 150				
Theory:100		**Practical:50**		
Final Exam (SEE)	**Internal Assessment (CT+TA)**	**Final Exam (SEE)**	**Internal Assessment (CT+TA/PR)**	
75	**25**	**37**	**13**	

Unit 1 Introduction No. of Hours: 4
Concept of Innate and Adaptive immunity; Contributions of following scientists to the development of field of immunology - Edward Jenner, Karl Landsteiner, Robert Koch, Paul Ehrlich, Elie Metchnikoff, Peter Medawar, MacFarlane Burnet, Neils K Jerne, Rodney Porter and Susumu Tonegawa.

Unit 2 Immune Cells and Organs No. of Hours: 7
Structure, Functions and Properties of: Immune Cells – Stem cell, T cell, B cell, NK cell, Macrophage, Neutrophil, Eosinophil, Basophil, Mast cell, Dendritic cell; and Immune Organs – Bone Marrow, Thymus, Lymph Node, Spleen, GALT, MALT, CALT.

Unit 3 Antigens No. of Hours: 4
Characteristics of an antigen (Foreignness, Molecular size and Heterogeneity); Haptens; Epitopes (T & B cell epitopes); T-dependent and T-independent antigens; Adjuvants.

Unit 4 Antibodies No. of Hours: 6
Structure, Types, Functions and Properties of antibodies; Antigenic determinants on antibodies (Isotypic, allotypic, idiotypic); VDJ rearrangements; Monoclonal and Chimeric antibodies.

Unit 5 Major Histocompatibility Complex No. of Hours: 5

Organization of MHC locus (Mice & Human); Structure and Functions of MHC I & II molecules; Antigen processing and presentation (Cytosolic and Endocytic pathways).

Unit 6 Complement System No. of Hours: 4

Components of the Complement system; Activation pathways (Classical, Alternative and Lectin pathways); Biological consequences of complement Activation.

Unit 7 Generation of Immune Response No. of Hours: 10

Primary and Secondary Immune Response; Generation of Humoral Immune Response (Plasma and Memory cells); Generation of Cell Mediated Immune Response (Self MHC restriction, T cell activation, Co- stimulatory signals); Killing Mechanisms by CTL and NK cells, Introduction to tolerance.

Unit 8 Immunological Disorders and Tumour Immunity No. of Hours:10

Types of Autoimmunity and Hypersensitivity with examples; Immunodeficiency - Animal models (Nude and SCID mice), SCID, DiGeorge syndrome, Chediak- Higashi syndrome, Leukocyte adhesion deficiency, CGD; Types of tumours, tumour Antigens, causes and therapy for cancers.

Unit 9 Immunological Techniques No. of Hours: 10

Principles of Precipitation, Agglutination, Immunodiffusion, Immunoelectrophoresis, ELISA, ELISPOT, Western blotting, Immunofluorescences, Flow cytometry, Immunoelectron microscopy.

SUBJECT TITLE: IMMUNOLOGY (PRACTICAL)
SUBJECT CODE: - BSMB-MN-303-P CREDITS: 1 TOTAL HOURS: 30

1. Identification of human blood groups.
2. Perform Total Leukocyte Count of the given blood sample.
3. Perform Differential Leukocyte Count of the given blood sample.
4. Separate serum from the blood sample (demonstration).
5. Perform immunodiffusion by Ouchterlony method.
6. Perform DOT ELISA.
7. Perform Immunoelectrophoresis.

Suggested readings:

1. Goldsby RA, Kindt TJ, Osborne BA. (2013). Kuby's Immunology. 7th edition W.H. Freeman and Company, New York.
2. Richard C and Geiffrey S. (2015). Immunology. 7th edition. Wiley Blackwell Publication.
3. Abbas AK, Lichtman AH, Pillai S. (2007). Cellular and Molecular Immunology. 6th edition Saunders Publication, Philadelphia.
4. Delves P, Martin S, Burton D, Roitt IM. (2006). Roitt's Essential Immunology.11th edition WileyBlackwell Scientific Publication, Oxford.
5. Murphy K, Travers P, Walport M. (2008). Janeway's Immunobiology. 7th edition Garland Science Publishers, New York.
6. Peakman M, and Vergani D. (2009). Basic and Clinical Immunology. 2nd edition Churchill Livingstone Publishers, Edinberg.

University of Patanjali, Haridwar

Syllabus of B.Sc. Microbiology under NEP

SUBJECT TITLE: Organic Chemistry (THEORY)
SUBJECT CODE: - BSMB-ID-303
SEMESTER – III, TOTAL HOURS: 60 CREDITS: 4

Objectives:

1. Basic concepts involved in of bonding, nomenclature and structure in organic compounds.
2. To understand the core concepts of organic chemistry i.e. resonance, hyper conjugation, inductive effect.
3. To acquire basic knowledge of reactive intermediates and mechanism of organic reactions
4. To analyses and elucidate the functional group in aliphatic and aromatic compounds.
5. To understand chemistry in everyday life.
6. To study about the Biodegradable and non-biodegradable polymers.

Total Number of Hrs.: 60		**Theory**	**Practical**	**Tutorial**
Credits		3	1	-
Hrs/Week		3	2	-
SCHEME OF EXAMINATION				
Total marks: 150				
Theory: 100		**Practical: 50**		
Final Exam (SEE)	**Internal Assessment (CT+TA)**	**Final Exam (SEE)**	**Internal Assessment (CT+TA/PR)**	
75	**25**	**37**	**13**	

Unit-1.

Introduction to organic compounds, Nature of chemical bonds, Dipole moment, Organic acids and Bases.

Unit-2.

Electronic Displacements: Inductive Effect, Electrometric Effect, Mesmeric effect. Resonance and Hyper conjugation. Cleavage of Bonds: Haemolysis and Heterolysis. Reaction intermediates: Carbocation, Carbanions and free radicals. Types of organic reactions and their mechanism.

Unit-3.

Aliphatic Hydrocarbons, alkenes, alkynes, Alkyl Halides, Alcohols, Phenols, Esters, Aldehydes and ketones, Carboxylic acids, Amines (General preparations, reactions and physical properties).

Unit-4.

Aromatic hydrocarbons and aromaticity- Structure of benzene, Aromatic Character, Nomenclature, Aromatic reactions and their mechanism.

Unit-5.

Polymers- Definition, Classification, and polymerization reactions (addition and coordination). Synthesis and applications of some important polymers: like polythene, nylon, polyesters, etc. Chemistry in everyday life, medicines, soaps & detergents, green chemistry

SUBJECT TITLE: Organic Chemistry (PRACTICAL)
SUBJECT CODE: - BSMB-ID-303-P CREDITS: 1 TOTAL HOURS: 30

1. Introduction to organic chemistry practical
2. Detection of elements in organic compounds
3. Oxidation of alcohols to acid using Jones reagent
4. Estimation of sugars by using Fehling solution
5. Tollens reagent test of organic compounds
6. Carbylamines test of amines
7. Synthesis of Acetanilide
8. Determination of saponification value of the given oil

Books recommended:

1. Morrison, R. T. & Boyd, R. N. Organic Chemistry, Seventh Edition, 2019 Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Finar, I. L. Organic Chemistry (Volume 1), Sixth Edition, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
3. Finar, I. L. Organic Chemistry (Volume 2), Sixth Edition, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
4. Nelson, D. L. & Cox, M. M. Lehninger's Principles of Biochemistry 7th Ed., W. H. Freeman.
5. Berg, J. M., Tymoczko, J. L. &Stryer, L. Biochemistry 7th Ed., W. H. Freeman

University of Patanjali, Haridwar

Syllabus of B.Sc. Microbiology under NEP

SUBJECT TITLE: BIOSTATISTICS & DATA SCIENCE (THEORY)
SUBJECT CODE: - BSMB-AE-304
SEMESTER – III, TOTAL HOURS: 60 CREDITS: 3

Course Objectives:

1. It helps learners to analyze data from various biological experimental problems.
2. It helps to determine the appropriate sampling techniques and coordinate data collection
   Procedures.
3. It helps to conduct statistical analyses to answer scientific questions.

Total Number of Hrs.: 60		**Theory**	**Practical**	**Tutorial**
Credits		3	0	-
Hrs/Week		3	0	-
SCHEME OF EXAMINATION				
Total marks: 100				
Theory:100		**Practical:00**		
Final Exam (SEE)	**Internal Assessment (CT+TA)**	**Final Exam (SEE)**	**Internal Assessment (CT+TA/PR)**	
75	**25**	**00**	**00**	

Unit-1 Biostatistics (8Hrs)

Definition –statistical methods – basic principles, Variables-measurements, functions, limitations and uses of statistics. Collection of data primary and secondary. Types and methods of data collection procedures and demerits. Classification-tabulation and presentation of data-sampling methods.

Unit-2 Measures of central tendency (8Hrs)

Mean, median, mode, geometric mean – merits & demerits. Measures of dispersion range, standard deviation, mean deviation, quartile deviation-merits and demerits; Co-efficient of variations.

Unit 3 Correlation (12 Hrs)

Correlation: Types and methods of correlation, regression, simple regression equation, fitting prediction, similarities and dissimilarities of correlation and regression. Statistical inference: Hypothesis- simple hypothesis – student‘t’ test –chi-square test.

Unit-4 -Introduction to data science (9Hrs)

Definition – Big Data and Data Science Hype – Why data science – Getting Past the Hype – The Current Landscape –Data Science Process Overview – Defining goals – Retrieving data – Data preparation – Data exploration – Data modelling – DBMS-Presentation.

Unit-5 - Data visualization (9HRS)

Introduction to data visualization – Data visualization options – Filters – Map Reduce – Dashboard development tools – Creating an interactive dashboard with dc.js-summary.

SUGGESTED READINGS

1. Danniel, W.W. (1987), Biostatistics, New York, John Wiley Sons.
2. Banerjee, P. (2001), Introduction to Biostatistics, S. Chand Publication, Delhi.
3. Goon, Gupta & das Gupta: Fundamentals of Statistics Vol II, Calcutta: The world press.
4. Introducing Data Science, Davy Cielen, Arno D. B. Meysman, Mohamed Ali, Manning Publications Co., 1st edition, 2016.
5. Data Science from Scratch: First Principles with Python, Joel Grus, O'Reilly, 1st edition, 2015

University of Patanjali, Haridwar

Syllabus of B.Sc. Microbiology under NEP

SUBJECT TITLE: HERBAL DRUG DEVELOPMENT (THEORY)
SUBJECT CODE: - BSMB-SE-305
SEMESTER – III, TOTAL HOURS: 45 CREDITS: 3

Course Objectives:

1. Identify and authenticate the herbal drugs.
2. To make the students aware of the novel properties of herbal plants.
3. To make the students expert in identifying the medicinal plants available in their locality, irrespective of the field to which he/she belongs.
4. To learn to identify the most common and useful herbal plants

Total Number of Hrs.: 45	**Theory**	**Practical**	**Tutorial**
Credits	3	0	-
Hrs/Week	3	0	-

SCHEME OF EXAMINATION			
Total marks: 100			
Theory:100		**Practical:00**	
Final Exam (SEE)	**Internal Assessment (CT+TA)**	**Final Exam (SEE)**	**Internal Assessment (CT+TA/PR)**
75	**25**	**00**	**00**

UNIT-I 11 Hours

Herbs as raw materials Definition of herb, herbal medicine, herbal medicinal product, herbal drug preparation Source of Herbs Selection, identification and authentication of herbal materials Processing of herbal raw material Biodynamic Agriculture Good agricultural practices in cultivation of medicinal plants including Organic farming. Pest and Pest management in medicinal plants: Biopesticides/Bioinsecticides. Indian Systems of Medicine a) Basic principles involved in Ayurveda, Siddha, Unani and Homeopathy b) Preparation and standardization of Ayurvedic formulations viz Aristas and Asawas, Ghutika,Churna, Lehya and Bhasma.

UNIT-II 7 Hours

Nutraceuticals General aspects, Market, growth, scope and types of products available in the market. Health benefits and role of Nutraceuticals in ailments like Diabetes, CVS diseases, Cancer, Irritable bowel syndrome and various Gastro intestinal diseases. Study of following herbs as health food: Alfa alfa, Chicory, Ginger, Fenugreek, Garlic, Honey, Amla, Ginseng,

Ashwagandha, Spirulina Herbal-Drug and Herb-Food Interactions: General introduction to interaction and classification. Study of following drugs and their possible side effects and interactions: Hypercium, kava-kava, Ginkobiloba, Ginseng, Garlic, Pepper & Ephedra.

UNIT-III 10 Hours

Herbal Cosmetics 134 Sources and description of raw materials of herbal origin used via, fixed oils, waxes, gums colours, perfumes, protective agents, bleaching agents, antioxidants in products such as skin care, hair care and oral hygiene products. Herbal excipients: Herbal Excipients – Significance of substances of natural origin as excipients – colorants, sweeteners, binders, diluents, viscosity builders, disintegrants, flavors & perfumes. Herbal formulations: Conventional herbal formulations like syrups, mixtures and tablets and Novel dosage forms like phytosomes.

UNIT- IV 10 Hours

Evaluation of Drugs WHO & ICH guidelines for the assessment of herbal drugs Stability testing of herbal drugs. Patenting and Regulatory requirements of natural products: a) Definition of the terms: Patent, IPR, Farmers right, Breeder's right, Bioprospecting and Biopiracy b) Patenting aspects of Traditional Knowledge and Natural Products. Case study of Curcuma & Neem. Regulatory Issues - Regulations in India (ASU DTAB, ASU DCC), Regulation of manufacture of ASU drugs - Schedule Z of Drugs & Cosmetics Act for ASU drugs.

UNIT-V 07 Hours

General Introduction to Herbal Industry Herbal drugs industry: Present scope and future prospects. A brief account of plant-based industries and institutions involved in work on medicinal and aromatic plants in India. Schedule T – Good Manufacturing Practice of Indian systems of medicine Components of GMP (Schedule – T) and its objectives Infrastructural requirements, working space, storage area, machinery and equipment, standard operating procedures, health and hygiene, documentation and record

Recommended Books: (Latest Editions)

1. Textbook of Pharmacognosy by Trease & Evans.
2. Textbook of Pharmacognosy by Tyler, Brady & Robber.
3. Pharmacognosy by Kokate, Purohit and Gokhale
4. Essential of Pharmacognosy by Dr.S.H.Ansari
5. Pharmacognosy & Phytochemistry by V.D.Rangari
6. Pharmacopoeal standards for Ayurvedic Formulation (Council of Research in Indian Medicine & Homeopathy).

University of Patanjali, Haridwar

Syllabus of B.Sc. Microbiology under NEP

SUBJECT TITLE: **Yagna Chikitsha**

SUBJECT CODE: - BSMB-VA-306 SEMESTER – III, TOTAL HOURS: 30

CREDITS: 3

Total Number of Hrs. : 30		Theory	Practical	Tutorial
Credits		3	-	-
Hrs/Week		3	-	-
SCHEME OF EXAMINATION				
Total marks: 100				
Theory:100		Practical:00		
Final Exam (SEE)	Internal Assessment (CT+TA)	Final Exam (SEE)	Internal Assessment (CT+TA/PR)	
75	25	-	-	

पाठ्यक्रम के उद्देश्यः–

- यज्ञ के शास्त्रीय अर्थ से परिचय कराना तथा यज्ञों के प्रकार पर प्रकाश डालना।
- ऋषि परम्परा से चले आ रहे इस वैज्ञानिक यज्ञ चिकित्सा का बोध कराना।
- सृष्टि चक्र के संतुलन के परिपेक्ष्य में यज्ञीय विधान का परिचय।
- आत्मिक, शारीरिक, मानसिक, आध्यात्मिक, सामाजिक, वैश्विक समस्याओं/रोगों के समाधान पर्यावरण संरक्षण एवं सुख शांति हेतु।

इकाई प्रथम–

1. वैदिक धर्म एवं वैदिक देवताओं का परिचय एवं इतिहास।
2. यज्ञ संस्था का परिचय एवं विवेचन।
3. यज्ञ के प्रकार एवं उपदेयता एवं वैज्ञानिकता।
4. नित्य पंचमहायज्ञ (ब्रह्मयज्ञ, देवयज्ञ, पितृयज्ञ, बलिवैश्वदेवयज्ञ, अतिथियज्ञ)

इकाई द्वितीय–

1. यज्ञीय पदार्थ– हवनकुण्ड आदि पात्र, समिधा, सामग्री व घी।
2. यज्ञ प्रक्रिया विधि– आचमन, अंङ्ग स्पर्शन, ईश्वर–स्तुतिप्रार्थनोपासना, द्वीप प्रज्जवलन, अग्न्याधान इत्यादि।

इकाई तृतीय–

1. यज्ञकुण्ड का परिमाण एंव स्वरुप एवं मंत्रविज्ञान।
2. शास्त्रों में यज्ञ की महिमा–बल, शत्रुपराजय, ऐश्वर्य, स्वर्ग कल्याणादि।
3. नैमत्तिक–16 संस्कार, भूमि पूजन, गृह प्रवेश, होली, दीपावली पर्व आदि।
4. काम्य–पुत्रेष्टि, वर्षेष्टि, शारीरिक व मानसिक रोग हेतु यज्ञ। कृषि वर्षा पर्यावरण यज्ञ।
5. .विभिन्न समप्रदायों में यज्ञ एवं उसकी प्रक्रियाएं।

इकाई चतुर्थ–

1. यज्ञ चिकित्सा/थरेपी
2. यज्ञ चिकित्सा का शास्त्रीय प्रमाण–वेदादि शास्त्रों में रोग निवारण हेतु बताये गये मन्त्र–श्लोक।
3. यज्ञ चिकित्सा के वैज्ञानिक प्रमाण–अनेक वैज्ञानिकों द्वारा किये गये शोध का विवरण।
4. . रोगानुसार हवन सामग्री–प्राणेष्टि, मेधेष्टि, पित्तेष्टि, कफेष्टि, कर्कटष्टि, वातेष्टि, चर्मेष्टि, सन्ततीष्टि, हदयेष्टि, मधु–इष्टि, दिव्येष्टि, प्रारब्धेष्टि, गुग्गल।

इकाई पंचम–

मंत्र स्मरण एवं उच्चारण

निर्धारित पाठ्यपुस्तक–

- यज्ञ–योग–आयुर्वेद चिकित्सा एवं यज्ञ दर्शन, वैदिक नित्यकर्म विधि
- वैदिक साहित्य एवं संस्कृति, डॉ0 कपिलदेव द्विवेदी।
- संध्योपासना विधि– पतंजलि योगपीठ।
- पंच महायज्ञ विधि– महर्षि दयानन्द।

4TH SEMESTER

University of Patanjali, Haridwar
Syllabus of B.Sc. Microbiology under NEP

Core Course
COURSE DETAILS
SUBJECT TITLE: MICROBIAL PHYSIOLOGY AND METABOLISM (THEORY)
SUBJECT CODE: - BSMB-MJ-401
SEMESTER – IV

CREDITS: 3+1

Course Objectives:

1. It gives brief description on the microbial metabolism and its energetics
2. It deals with the various aerobic and anaerobic processes through which the organisms obtain and utilize the energy for their growth.

Course Outcome:

1. Describing the growth characteristics of the microorganisms capable of growing under unusual environmental condition of temperature, oxygen, and solute and water activity and how these are manifested in the form of different metabolic pathways in microorganisms.
2. Describing the growth characteristics of the microorganisms, which require different nutrient for growth, and the associated mechanisms of energy generation for their survival like autotrophs, heterotrophs, chemolitho autotrophs etc.

		Theory	**Practical**	**Tutorial**
Credits		**3**	**1**	**-**
Hrs/Week		**3**	**2**	**-**
SCHEME OF EXAMINATION				
Total marks: 150				
Theory:100		**Practical:50**		
Final Exam (SEE)	**Internal Assessment (CT+TA)**	**Final Exam (SEE)**	**Internal Assessment (CT+TA/PR)**	
75	**25**	**37**	**13**	

Unit I: Microbial Growth **10hrs**

Definitions of growth; Batch culture; Continuous culture; Generation time and specific growth rate; Temperature and pH ranges of growth; Effect of solute and water activity on growth ;Effect of oxygen concentration on growth; Nutritional categories of microorganisms.

Unit II: Nutrient Uptake and Transport **10hrs**

Passive and facilitated diffusion; Primary and secondary active transport; Concept of uniport, symport and antiport; Group translocation; Iron uptake.

Unit III: Phototropy and Autotrophy 10hrs

Phototrophic metabolism: Introduction, Groups of phototrophic microorganisms, Photosynthetic and accessory pigments, Anoxygenic vs. oxygenic photosynthesis with reference to photosynthesis in green bacteria and cyanobacteria. Carbon fixation pathways

Unit IV: Carbon Catabolism 10hrs

Concept of aerobic and anaerobic respiration; Sugar degradation pathways: EMP, ED, Pentose phosphate pathway, TCA cycle, Electron transport chain: Components of respiratory chain, Comparison of mitochondrial and bacterial ETC, Electron transport phosphorylation, Uncouplers and inhibitors. Fermentation: Alcohol and Lactate fermentation,

Unit V: Nitrogen Metabolism 5hrs

An overview of Nitrogen cycle, Biological nitrogen fixation, Nitrification, Nitrate reduction, Denitrification, and Anammox.

BSMB-MJ-401-P MICROBIAL PHYSIOLOGY AND METABOLISM (PRACTICAL) TOTAL HOURS: 30 CREDITS: 01

1. Study and plot the growth curve of E. coli by turbidiometric and standard plate count methods.
2. Calculations of generation time and specific growth rate of bacteria from the graph plotted with the given data.
3. Biochemical identification of bacteria; catalase, oxidase,
4. Effect of temperature on growth of E. coli
5. Effect of pH on growth of E. coli
6. Demonstration of alcoholic fermentation
7. Demonstration of the thermal death time and decimal reduction time of E. coli
8. Study and plot the growth curve of E. coli by turbidiometric and standard plate count methods.
9. Calculations of generation time and specific growth rate of bacteria from the graph plotted with the given data.

Suggested Readings:

1. Moat A.G. and Foster, J.W. (2009). Microbial physiology. John Wiley and Sons, New York, 4th Ed paperback.
2. Reddy, S.R.and Reddy, S.M. (2022). Microbial physiology. 2nd Ed.Scientific Publishers, India.
3. Gottschalk, G.(2012).Bacterial metabolism. Springer Verlag, NewYork, 2nd ed.
4. Prescott, Harley, Klein's Microbiology, J.M. Willey, L.M. Sherwood, C.J. Woolverton, 12th edition 2023, McGraw Hill.

University of Patanjali, Haridwar

Syllabus of B.Sc. Microbiology under NEP

Core Course

COURSE DETAILS

SUBJECT TITLE: Food and Dairy Microbiology

SUBJECT CODE: - BSMB-MN-402

SEMESTER – IV

CREDITS: 3+1=4

Course Objectives:

- This course will help understand the current trends and concepts related to Microbiology of food and other dairy products.

- Gives an insight into various types of food borne diseases and their prevention.

Course Outcomes:

CO1: Understand the significance and activities of microorganisms in food the role of intrinsic and extrinsic factors on growth and survival of microorganisms and attain information on microbial food spoilage.

CO2: Understand the principles in traditional food preservation techniques including salting, pickling, refrigeration, freezing, oxidation, and canning/bottling and chemical preservation. CO3: Analyze types of starter cultures like Lactic acid bacteria, fermented milk products, probiotics, SCP and Edible mushrooms.

CO4: Acquire& remember the microbes causing food intoxications and food infections.

	Theory	**Practical**	**Tutorial**
Credits	**3**	**1**	**-**
Hrs/Week	**3**	**2**	**-**
SCHEME OF EXAMINATION			
Total marks: 150			
Theory:100		**Practical:50**	
Final Exam (SEE)	**Internal Assessment (CT+TA)**	**Final Exam (SEE)**	**Internal Assessment (CT+TA/PR)**
75	**25**	**37**	**13**

Unit: 1 Introduction to Food microbiology (7 hrs)

Microbiology of foods: Foods as a substrate for microorganisms, Intrinsic and extrinsic parameters that affect the microbial growth in food. Survival of microbes in foods. natural

flora and source of contamination of foods in general. Identification of specific groups – Bacteria, Viruses, Fungi and Protozoa. Food sanitation and control.

Unit: 2 Food spoilage and food borne infections: (8 hrs)

Classification of Food: Perishable, Semi-perishable, stable, Health food, ethnic food, organic food, functional food, Nutraceuticals, fabricated foods, Convenience foods, GM foods, space foods. Microbial spoilage of food: Spoilage of canned foods, cereals, fruits, vegetables, bread, eggs, meat and fish. Food intoxication -Staphylococcal poisoning, botulism, Food infection – Salmonellosis, Shigellosis, Bacillus, Vibrio parahemolyticus, Listeria, Escherichia coli, Shigella, , Salmonella typhimurium, Campylobacter, Brucella, Yersinia etc. Mycotoxins produced by fungi - Aflatoxins in stored food and grains.

Unit: 3 Food preservation: (7 hrs)

Principles of food preservation -Methods of food preservation- Physical methods-high temperature, canning, freezing, dehydration, and radiation. chemical methods- salt, sugar, organic acids, SO2, nitrite and nitrates, ethylene oxide, antibiotics and bacteriocins Organic acids, nitrates and cresols. Food processing- Thermal processing, Chemical processing (Sugar, Salt, Smoke, acid and chemicals). Packaging materials

Unit: 4 Food products produced using microorganisms: (8 hrs)

Fermented Foods: Dairy starter cultures, fermented dairy products: yogurt and cheese (Types and Production), other fermented foods: acidophilus milk, kumiss, kefir, dahi, dosa, sauerkraut, soy sauce and tampeh, Microorganisms as food – single cell protein, yeast, algae and fungal organisms. Mushrooms: Types and cultivation, Probiotics: Health benefits, types of microorganisms used, probiotic foods available in market.

Unit: 5 Microbiology of milk and milk products: (10 hrs)

Definition and Composition of milk, Types of Milk (skimmed, toned and homogenized), Factors affecting quality and quantity of milk, Nutritive value of milk, Physical and Chemical properties of milk. Microbiology of milk: Common micro-organisms found in milk, Fermentation and spoilage of milk, Milk borne diseases. Milk preservation and storage: Methods of Pasteurization – LTH, HTST, UHT, storage specifications after pasteurization, phosphatase test and its significance. Microbial analysis of milk: Dye reduction test (using methylene blue and resazurin), total microbial count, Brucella ring test and tests for mastitis, Somatic cell count. Milk products: Starter cultures, Buttermilk, yoghurt, cheese, and other dairy products like milk powder, ice creams etc.

Unit: 6 Food beverages and enzymes: (10 hrs)

Concept of human microbiome, probiotics and prebiotics. Insight into health benefits of fermented milk products. Understanding benefits of tradition and non-traditional fermented foods. Introduction to the concept of bioactive compounds and brief study of such compounds from fermented foods including malt beverages, wines, distilled liquors and vinegar.

References:

1) Adams MR and Moss MO (1995), Food Microbiology. Royal Society of Chemistry Publication, Cambridge.

2) Banwart G. J. (1989). Basic Food microbiology, 2nd Edn. Chapman and Hall. International Thompson Publishing.

3) Clarence Henry Eckles, Willes Barnes Combs, Harold Macy (1943). Milk and milk products, 4th Ed. McGraw-Hill book Company, Incorporated.

4) James M. Jay, Martin J. Loessner, David A. Golden (2005). Modern food microbiology, 7th Edn. Springer Science & Business.

5) Sukumar. De (2001). Outlines of Dairy Technology. 1st Ed. Oxford University Press Delhi. 6) William C. Frazier, Dennis C. Westhoff, N. M. Vanitha (2013). Food Microbiology, 5thEdn.McGraw-Hill Education (India).

7) Prajapati JB (1995) Fundamentals of Dairy Microbiology. Nadiad Akta Prakashan.

8) Stanbury PF, Whitekar A and Hall SJ (1995) Principles of Fermentation Technology, 2nd edition. Pergamon Press.

BSMB-MN-402-PFood and Dairy Microbiology (Practical)

1. Isolation and identification of microbes from infected fruits and vegetables
2. Isolation and identification of microbes from fermented foods and pickles
3. Isolation and identification of microbes from home-made and commercial curd
4. Preparation of yogurt
5. To analyse the quality of milk and dairy products by following methods a. Phosphatase test b. MBRT test c. Test for mastitis d. Milk fat estimation e. Standard Plate Count (for milk / milk product e.g. milk powder) f. Direct Microscopic count g. Somatic cell count 6. Estimation of fat content of milk by Gerber's method
6. Determination of microbiological quality (TPC/SPC) of any food sample: pasteurized and sterilized/ flavoured milk/cheese/butter/veg/fruit/bread/meat samples.
7. Quality assurance tests: Antibiotic and growth factor assay (agar gel diffusion technique) / MIC and MBC of Antibacterial compounds
8. Production of ethanol from wine / vinegar from apple or grapes etc.

University of Patanjali, Haridwar

Syllabus of B.Sc. Microbiology under NEP

SUBJECT TITLE: GENETICS (THEORY)
SUBJECT CODE: - BSMB-ID-403
SEMESTER – IV, TOTAL HOURS: 60 CREDITS: 4
Course Objectives:

1. Apply Quantitative problem-solving Skills to genetics problems and issues.
2. Demonstrate their ability to reason both inductively and deductively with experimental information and data.
3. Select and apply experimental procedures to solve genetic problems.
4. To make the students understand the functional aspect of genes.

Total Number of Hrs.: 60		**Theory**	**Practical**	**Tutorial**
Credits		3	1	-
Hrs/Week		3	2	-
SCHEME OF EXAMINATION				
Total marks: 150				
Theory:100		**Practical:50**		
Final Exam (SEE)	**Internal Assessment (CT+TA)**	**Final Exam (SEE)**	**Internal Assessment (CT+TA/PR)**	
75	**25**	**37**	**13**	

Unit 1: Mendelian Genetics and Extensions [12 HRS]
Mendel's work on the transmission of traits, Genetic Variation, and Molecular basis of Genetic Information. Principles of Inheritance, Chromosome theory of inheritance, Laws of probability, Pedigree analysis, Incomplete dominance and co-dominance, Multiple alleles, Lethal alleles, Epistasis and Pleiotropy.

Unit 2: Linkage, Crossing over and Chromosomal Mapping [10 HRS]
Linkage and Crossing over, cytological basis of crossing over, Molecular mechanism of crossing over. Recombination frequency as a measure of linkage intensity, two factor and three factor crosses, Interference and Coincidence.

Unit 3: Mutations [12 HRS]
Chromosomal mutations, Deletion, Duplication, Inversion, Translocation, Aneuploidy and Polyploidy; Gene mutations: Induced v/s Spontaneous, Back v/s Suppressor mutations. Molecular basis of mutations, UV light and chemical mutagens, Detection of mutations: ClB method, Attached X-method, DNA repair mechanisms.

Unit 4: Genome Dynamics-Transposable Genetic Elements [10 HRS]
Prokaryotic transposable elements, IS elements, Composite transposons, Tn-3 elements; Eukaryotic transposable elements- Ac-Ds system in maize and P-elements in drosophila; Importance of transposons.

Unit 5: Extrachromosomal Inheritance [08 HRS]
Chloroplast mutation/Variegation in four 'o clock plant and Chlamydomonas, Mitochondrial mutations in Neurospora and yeast, Maternal effects, Infective Heredity-Kappa particles in Paramecium

Unit: 6 Population and Evolutionary Genetics [08 HRS]
Concept of population, Allele frequencies, Genotype frequencies, Gene pool, Hardy-Weinberg Law, role of natural selection, Genetic drift.

SUBJECT TITLE: GENETICS (PRACTICAL)
SUBJECT CODE: - BSMB-ID-403-P CREDITS: 1 TOTAL HOURS: 30

1. To study different types of Cell divisions using permanent slides (Mitosis and Meiosis).
2. Laboratory exercises on monohybrid, dihybrid, and test cross and back cross.
3. Pedigree analysis for dominant and recessive autosomal and sex-linked traits.
4. Incomplete dominance and gene interaction through seed ratios (9:7, 9:6:1, 13:3, 15:1, 12:3:1,9:3:4)
5. Chromosome mapping using point test cross data.
6. Laboratory exercises in probability.
7. Photographs/permanent slides showing Translocation Ring, Laggard's and Inversion bridge.
8. Demonstration of DNA Fingerprinting.
9. Exercise using RAPD Markers.

SUGGESTED READINGS:

1. Genetics (2021) 6th ed., Snustad, D.P. and Simmons, M.J., John Wiley & Sons. (Singapore), ISBN: 978-1-118-09242-2.
2. Genetics - A Conceptual Approach (2022), 4th ed., Pierce, B.A., W.H. Freeman & Co. (New York), ISBN:13:978-1-4292-7606-1 / ISBN:10:1-4292-7606-1.
3. An Introduction to Genetic Analysis (2018), 10th ed., Griffiths, A.J.F, Wessler, S. R, Carroll, S. B. and Doebley, J., W.H. Freeman & Company (New York), ISBN:10: 1-4292-2943-8.
4. Genetics (2022)- P.K Gupta.

University of Patanjali, Haridwar

Syllabus of B.Sc. Microbiology under NEP

COURSE DETAILS
SUBJECT TITLE: INDUSTRIAL MICROBIOLOGY (THEORY)
SUBJECT CODE: - BSMB-AE-404
SEMESTER – IV

CREDITS: 3+1=4

Course Objective:

1. To teach students about the use of microorganisms to produce products and services, and to develop their technical and theoretical skills.
2. To learn about microbial metabolites and their usefulness

Course Outcome:

1. Students gather fairly knowledge of how microbes are used in the fermentative production of organic acids, alcohols, enzymes, antibiotics
2. Students get knowledge of various physical parameters, which affect production of industrial products by the microorganisms, and the safety aspects of the production.

	Theory	Practical	Tutorial
Credits	**3**	**1**	**-**
Hrs/Week	**5**	**2**	**-**
SCHEME OF EXAMINATION			
Total marks: 150			
Theory:100		**Practical:50**	
Final Exam (SEE)	**Internal Assessment (CT+TA)**	**Final Exam (SEE)**	**Internal Assessment (CT+TA/PR)**
75	**25**	**37**	**13**

Unit 1: Introduction to Industrial Microbiology **No. of Hours:10**

Fermentation and pasteurization; Alexander Fleming: Discovery of antibiotics; Carl Neuberg: Enzyme fermentation); Fermented foods, additives, and enzymes; industrial products by the microorganisms, and the safety aspects of the production.

Unit 2: Fermentation Technology **No. of Hours:10 hours**

Principles of fermentation; Types of fermentations: Submerged and solid-state; types of cultures: batch, fed-batch and continuous; Inoculum development; basic design and functions of different part of fermenter/bioreactor; Types of bioreactors; Scale-up and scale-down processes; Downstream processing and product recovery.

Unit 3: Microbiology for Industrial production **No. of Hours: 15 hours**

Overview of microorganisms (Bacteria: Bacillus, Escherichia coli, Streptomyces; Fungi: Aspergillus, Penicillium; Yeasts: Saccharomyces cerevisiae; Algae: Chlorella, Spirulina;

Characteristics of industrially important microorganisms; Sources and isolation of industrial microorganisms; Preservation and maintenance of industrial strains; Primary and secondary screening techniques; use of recombinant DNA technology for strain improvement and industrial production.

Unit 4: Production of Industrial Products **No. of Hours: 10 hours**

Production of antibiotics (Penicillin & Streptomycin), alcohols (Ethanol &Butanol), enzymes (Amylase & Lipase), organic acids (Citric acid & lactic acid) and vitamins (B-12&C); Introduction and industrial production of Biopolymers and bioplastics.

BSMB-AE-404-P INDUSTRIAL MICROBIOLOGY (PRACTICAL)
TOTAL HOURS: 30 CREDITS: 01

1. Isolation of microorganisms from natural sources.
2. Quantitative estimation of amylase production by bacterial culture.
3. Isolation and screening of bacterial and fungal cultures for enzyme production
4. Quantitative estimation of lipase production by bacterial culture
5. Glucose fermentation and Ethanol production using yeast
6. Demonstration of antibiotic production and activity on agar plate.
7. Display of fermenter /bioreactor design

Suggested Readings:

1. Industrial Microbiology by L.E. Casida 2022 2nd Ed.
2. *Industrial Microbiology text book Edition*: *3rd (2017); by* Wulf *Crueger*, Anneliese *Crueger*, K.R. Aneja
3. Industrial Microbiology by Reed, G. Prescott and Dunn.4th Edition 2004
4. Industrial Microbiology: An Introduction by Michael J. Waites, Neil L. Morgan, John S. Rockey, Gary Higton 1st Edition 2013
5. Principles of Fermentation Technology by Peter F. Stanbury, Allan Whitaker, StephenJ. Hall 3rd Edition 2016
6. Microbial Biotechnology: Fundamentals of Applied Microbiology by Alexander N. Glazer, Hiroshi Nikaido 2nd Edition 2007
7. Industrial Biotechnology: Sustainable Growth and Economic Success edited by Wim Soetaert, Erick J. Vandamme (Latest Edition)
8. Modern Industrial Microbiology and Biotechnology by Nduka Okafor
9. Practical Fermentation Technology Edited by Brain McNeil and Linda M. Harvey

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SUBJECT TITLE: INSTRUMENTATION (THEORY)
SUBJECT CODE: - BSMB-SE-405
SEMESTER – IV, TOTAL HOURS: 45 CREDITS: 3

Total Number of Hrs.: 45		**Theory**	**Practical**	**Tutorial**
Credits		3	0	-
Hrs/Week		3	0	-
SCHEME OF EXAMINATION				
Total marks: 100				
Theory:100		**Practical:00**		
Final Exam (SEE)	**Internal Assessment (CT+TA)**	**Final Exam (SEE)**	**Internal Assessment (CT+TA/PR)**	
75	**25**	**00**	**00**	

1. Separation of mixtures by Chromatography: Measure the Rf value in each case (combination of two compounds to be given)
   (a) Identify and separate the components of a given mixture of 2 amino acids (glycine, aspartic acid, glutamic acid, tyrosine or any other amino acid) by paper chromatography
   (b) Identify and separate the sugars present in the given mixture by paper chromatography.
2. Optical methods of analysis: Origin of spectra, interaction of radiation with matter, fundamental laws of spectroscopy and selection rules, validity of Beer-Lambert's law. UV-Visible Spectrometry: Basic principles of instrumentation (choice of source, monochromator and detector) for single and double beam instrument; Basic principles of quantitative analysis: estimation of metal ions from aqueous solution, geometrical isomers, keto-enol tautomers.
3. Infrared spectroscopy: Interactions with molecules: absorption and scattering. Means of excitation (light sources), separation of spectrum (wavelength dispersion, time resolution), detection of the signal (heat, differential detection), interpretation of spectrum (qualitative, mixtures, resolution), advantages of Fourier Transform (FTIR).
4. NMR spectroscopy: Principle, Instrumentation, Factors affecting chemical shift, Spincoupling, Applications.
5. Mass spectroscopy: Making the gaseous molecule into an ion (electron impact, chemical ionization), Making liquids and solids into ions (electrospray, electrical discharge, laser desorption, fast atom bombardment), Separation of ions on basis of mass to charge ratio

6. Electrophoresis: Basic Principle of electrophoresis, Paper electrophoresis, Gel electrophoresis, discontinuous gel electrophoresis, PAGE, SDS-PAGE, Native and denaturing gels. Agarose gel electrophoresis, buffer systems in electrophoresis. Electrophoresis of proteins and nucleic acids, protein and nucleic acid blotting, detection and identification. Molecular weight determination
7. Centrifugation
   Principle of centrifugation, basic rules of sedimentation, sedimentation coefficient, various
   types of centrifuges, different types of rotors, differential centrifugation, density gradient centrifugation

Books: `

1. Principles of Instrumental Analysis - 6th Edition by Douglas A. Skoog, F. James Holler, and Stanley Crouch (ISBN 0-495-01201-7).
2. Instrumental Methods of Analysis, 7th ed, Willard, Merritt, Dean, Settle.
3. P.W. Atkins: Physical Chemistry.
4. G.W. Castellan: Physical Chemistry.
5. C.N. Banwell: Fundamentals of Molecular Spectroscopy.

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Syllabus of B.Sc. Microbiology under NEP

COURSE DETAILS
SUBJECT TITLE: IKS
SUBJECT CODE: - BSMB-VA-406
SEMESTER-IV CREDITS: 2

Total Number of Hrs.: 30		**Theory**	**Practical**	**Tutorial**
Credits		2	0	-
Hrs/Week		2	0	-
SCHEME OF EXAMINATION				
Total marks: 100				
Theory:100		**Practical:00**		
Final Exam (SEE)	**Internal Assessment (CT+TA)**	**Final Exam (SEE)**	**Internal Assessment (CT+TA/PR)**	
75	**25**	**00**	**00**	

UNIT 1:-

Indian Knowledge System (Part A) [15 HRS.]

CATURDASA VIDYASTHANA-S: 14 branches of learning in ancient India-purana, nyaya, Mimamsa, dharmasastra, six vedanga-s: (siksa, vyakarana, nirukta, chanda, jyotisa, kalpa) and four Vedas-Rigveda, yajurveda, samaveda and atharvaveda; introductory information on them. 18 PURANAS; their names and five general characteristics of purana-s-sarga, pratisarga, vamsa, manvantara and vamsanucarita.

UNIT 2:- Indian Knowledge System (Part B) [15 HRS.]

Introduction and Contribution of Ancient Indian gurukula System: Odantapuri, Mithila, Kanchi, Kasmira , Ujjain, Definitions and Meanings from various texts (mahabharata, manusmrti, vaisesika sutra). kamya, nitya, nisiddha, naimittika, prayascita & upasana. Meaning of the word artha-purusarhta; Root and derivation and meaning. Social outlook for tirthayatra, festivals, saptapuri, 12 jyotirlinga-s and unity of India.

Reference books:

1. An Introduction to Indian Knowledge Systems: Concepts and Applications, B Mahadevan, V R Bhat, and Nagendra Pavana R N; 2022 (Prentice Hall of India).
2. Indian Knowledge Systems: Vol I and II, Kapil Kapoor and A K Singh; 2005 (D.K. Print World Ltd).
3. Baladev Upadhyaya, Samskrta Śāstrom ka Itihās, Chowkhambha, Varanasi, 2010.
4. The Beautiful Tree: Indigenous India Education in the Eighteenth Century, Dharampal, Biblia Impex, New Delhi, 1983. Reprinted by Keerthi Publishing House Pvt Ltd., Coimbatore, 1995.

5. Indian Science and Technology in the Eighteenth Century, Dharampal. Delhi: Impex India, 1971. The British Journal for the History of Science.

6. D. M. Bose, S. N. Sen and B. V. Subbarayappa, Eds., A Concise History of Science in India, 2nd Ed., Universities Press, Hyderabad, 2010.

7. Dharampal, Some Aspects of Earlier Indian Society and Polity and Their Relevance Today, New Quest Publications, Pune, 1987.

8. Mohanty, J. N. (2008). A History of Indian Philosophy. A Companion to World Philosophies, 24–48.

9. Potter, K. H. (1987). Encyclopedia of Indian Philosophies Vol IV. Delhi, India: Motilal Banaridass Publishers.

10. Press, O. U. (1928). Indian Philosophy: A Very Short Introduction. Mind (Vol. 37).

11. Radhakrishnan, S., & Moore, C. A. (Eds.). (1957). A Source Book in Indian Philosophy. New Jersey, NJ: Princeton University Press.

12. Schweizer, P. (1993). Mind/ Consciousness Dualism in Sankhya-Yoga Philosophy.

13. Philosophy and Phenomenological Research, 53(4), 845–859. doi:10.2307/2108256

14. Timalsina, S. (2008). Consciousness in Indian philosophy: The Advaita doctrine of “awareness only.”

5TH SEMESTER

University of Patanjali, Haridwar

Syllabus of B.Sc. Microbiology under NEP

Core Course

COURSE DETAILS

SUBJECT TITLE: Soil and Agricultural microbiology

SUBJECT CODE: - BSMB-MJ-501

SEMESTER – V

CREDITS: 3+1=4

Course Objectives:

To study the importance and wealth of soil microbiota

To appreciate the role of microbes in biochemical cycling of nutrients

To know about the importance of plant pathology, bio-fertilizers and bio-pesticides.

To know about the importance of microbial interaction with organic pollutant and metals

Course Outcomes:

CO1: Thorough knowledge and understanding of concepts of soil and agricultural microbiology.

CO2: Learning and practicing professional skills in handling beneficial microbes.

CO3: Thorough knowledge and application of good laboratory and good manufacturing practices in soil and agro microbiology.

	Theory	**Practical**	**Tutorial**
Credits	**3**	**1**	**-**
Hrs/Week	**3**	**2**	**-**
SCHEME OF EXAMINATION			
Total marks: 150			
Theory:100		**Practical:50**	
Final Exam (SEE)	**Internal Assessment (CT+TA)**	**Final Exam (SEE)**	**Internal Assessment (CT+TA/PR)**
75	**25**	**37**	**13**

Unit -1 (**10 hrs)**

Soil microbiology - quantitative and qualitative micro flora of different soils-role of microbes in soil fertility-tests for soil fertility - soil structure, soil formation - characterization of soil types and importance.

Unit -2 (**10 hrs)**

Biogeochemical cycles-role of microorganisms in carbon, phosphorus. sulphur and iron cycles. Methods of studying ecology of soil microorganisms-microbial gas metabolism-carbon dioxide, hydrogen, and methane and hydrogen sulphide.

Unit -3 (**10 hrs)**

Microbial interactions between microorganisms, plant and soil. Rhizoplane, rhizosphere, phyllosphere, spermosphere, mycorrhizae. Microbial association with insects-gut micro flora - symbiosis between microbes and insects; organic matter decomposition.

Unit -4 (**10 hrs)**

Nitrogen cycle; ammonification- nitrification- de-nitrification- nitrogen fixation- Bio-fertilizers (bacterial, cyanobacteria and azolla) and crop response-bio-pesticides (bacterial, viral and fungal) saprophytes for pathogen suppression.

Unit -5 (**10 hrs)**

Principles of plant infection and defense mechanisms. Symptoms, Etiology, Epidemiology and Management of the following plant diseases: Mosaic disease of tobacco; Bunchy top of banana; Leaf roll of potato; Bacterial blight of paddy; Angular leaf spot of cotton, Late blight of potato; Damping off of tobacco, downy mildew of bajra; Powdery mildew of cucurbits; Head smut of sorghum; Leaf rust of coffee; Blight of maize/sorghum; Leafspot of paddy, Grassy shoot of sugar cane; Root knot of mulberry.

BSMB-MJ-501-P- Soil and Agricultural microbiology (PRACTICAL)

1. Methods to study soil microorganisms - Isolation and enumeration of Bacteria, Fungi, Bacteriophages, Algae, Protozoa etc.,
2. Microbiological test for fertility - Bacterial and Fungal
3. Microbiological demonstration of soil enzymes – Amylase, Protease, Lipase, Gelatinase etc.
4. Isolation and identification of root nodule bacteria Rhizobium(symbiotic)
5. Isolation and identification of Azotobacter (Asymbiotic).
6. Isolation and identification of nitrogen fixing Cyanobacteria, Anabaena and Nostoc etc
7. Antagonistic activity –bacterial and fungal.
8. Study of the following diseases: Tobacco mosaic; Bacterial blight of paddy; Downy mildew of bajra; Powdery mildew of cucurbits; Head smut of sorghum; Leaf rust of coffee; Leaf spot of paddy, Red rot of sugar cane, Root knot of mulberry

Suggested Reading:

1. Cambell, R. (1983) Microbial Ecology, 2nd Edn. Blackwell Scientific Publications, London.
2. Lynch, J.M. and Poole, N.J.(1979) Microbial Ecology: A. Conceptual Approach. Blackwell Scientific Publications, London.
3. Rheinheimer, G. (1980) Aquatic Microbilogy, 2nd Edn. John Wiley & Sons, New York.
4. Atlas, R.M. and Bartha, R. (1992) Microbial Ecology: Fundamentals and Applications, 2nd Edn. The Benjamin / Cummings Publishing Co.,Redwood City,CA.
5. Mitchell, R. (1974) Introduction to Environmental Microbiology. Prentice – Hall. Inc. New Jersey.
6. Subba Rao, N.S. (1995) Soil Microorganisms and Plant Growth. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
7. Paul, E.A. and Clark, F.E. (1989) Soil Microbiology and Biochemistry. Academic Press, London.
8. Subbha Rao, N.S. (1995) Biofertilizers in Agriculture and Forestry, 3rd Edn. Oxford & IBH Pub. Co. Pvt. Ltd., New Delhi.
9. Alexander M. (1977) Introduction to soil microbiology. John Wiley & Sons, Inc., New York.
10. Dirk J, Elas V, Trevors JT, Wellington, EMH (1997) Modern Soil Microbiology, Marcel Dekker INC, New York.
11. Ramanathan, and Muthukaruppan SM (2005) Environmental Microbiology. OmSakthi Pathipagam, Annamalai Nagar.
12. Bagyaraj, D.J. and A. Manjunath. 1990. Mycorrhizal symbiosis and plant growth, Univ. of Agricultural Sciences, Bangalore, India.
13. Purohit, S.S., P.R. Kothari and S.K. Mathur, 1993. Basic and Agricultural Biotechnology, Agro Botanical Pub. India.
14. Subba Rao, N. S. 1988. Biological nitrogen fixation: recent developments, Mohan Primlani for Oxford and IBH Pub. Co. (P) Ltd., India.
15. Subba Rao, N.S., G.S. Venkataraman and S. Kannaiyan 1993. Biological nitrogen fixation, ICAR Pub., New Delhi.
16. Somani, L.L., S.C. Bhandari, K.K. Vyas and S.N. Saxena. 1990. Biofertilizers, Scientific Publishers - Jodhpur.

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Syllabus of B.Sc. Microbiology under NEP

SUBJECT TITLE: MOLECULAR BIOLOGY (THEORY)
SUBJECT CODE: - BSMB-MN-502
SEMESTER – V, TOTAL HOURS: 60 CREDITS: 4

Course Objectives:

1. To understand the mechanisms of DNA replication, transcription, and translation
2. To describe how RNA, DNA, and Proteins are synthesized.
3. Understand how genes and chromosomes function.
4. Understand the central dogma of biology

Total Number of Hrs.: 60		**Theory**	**Practical**	**Tutorial**
Credits		3	1	-
Hrs/Week		3	2	-
SCHEME OF EXAMINATION				
Total marks: 150				
Theory:100		**Practical:50**		
Final Exam (SEE)	**Internal Assessment (CT+TA)**	**Final Exam (SEE)**	**Internal Assessment (CT+TA/PR)**	
75	**25**	**37**	**13**	

Unit 1 Molecular Biology [10 Hrs]

General principles - bidirectional replication, Semi-conservative, discontinuous. RNA priming, Various models of DNA replication. Enzyme involved in DNA replication – DNA polymerases, DNA ligase, primase, telomerase and other accessory proteins. Denaturation and renaturation of DNA, Cot curves.

Unit 2 The mutability and Repair of DNA [10 Hrs]

Replication Errors (Transitions, transversion and thymine dimer), DNA Damage (deamination, depurination and dimerization) and their repair: mismatch repair, SOS response (recombination), Excision Repair, Photoreactivation.

Unit 3 Information Transfer –I: Mechanism of Transcription [10Hrs]

Basic transcription apparatus, Initiation, elongation and termination of transcription, Eukaryotic transcription of mRNA, tRNA and rRNA, types of RNA polymerases, transcription factors, Inhibitors of transcription- rifampicin and α-amanitin. Reverse Transcription in virus.

Unit 4 Post-Transcriptional Modifications [10 Hrs]

Split Genes, Concept of introns and exons, RNA splicing, Spliceosomes and Self splicing introns, alternative splicing and exon shuffling, mRNA transport.

Unit 5 Information Transfer-II: Mechanism of Translation [5 Hrs]

Features of genetic code and exceptions in some systems, Ribosome structure- rRNA and proteins, charging of tRNA, aminoacyl tRNA synthetases, Proteins involved in initiation (in prokaryotes and eukaryotes), elongation and termination of polypeptides, Fidelity of translation, Inhibitors of protein synthesis – tetracyclines, aminoglycosides, chloramphenicol and aminoglycosides.

SUBJECT TITLE: MOLECULAR BIOLOGY (PRACTICAL)
SUBJECT CODE: - BSBS-MN-502-P CREDITS: 1 TOTAL HOURS: 30

1. Preparation of various stock solutions required for Molecular Biology Laboratory.
2. Preparation of culture medium (LB) for E. coli (both solid and liquid) and raise culture of E. coli.
3. Isolation of chromosomal DNA from bacterial cultures and visualization on Agarose Gel Electrophoresis.
4. Quantitative estimation of salmon sperm/ calf thymus DNA using colorimeter (Diphenylamine reagent) and Spectrophotometer (A260 measurement).
5. Isolation of genomic DNA from blood/ tissue.
6. Demonstration of Polymerase Chain Reaction (PCR) technique
7. Demonstration of AMES test or reverse mutation for carcinogenicity

Suggested readings:

1. Molecular Biology of the Gene, 6th edition (2007), Watson, J. D., Baker T. A., Bell, S. P., Gann, A., Levine, M., and Losick, R; Benjamin Cummings Publishers, ISBN-13: 978-0805395921.
2. Cell and Molecular Biology: Concepts and Experiments, 7th edition (2013), Gerald Karp. ; Wiley Publishers ISBN-13: 978-1118206737.
3. Molecular Cloning: A Laboratory Manual, 4th edition (2012), Michael R. Green and Joseph Sambrook; Cold Spring Harbor Laboratory Press, ISBN-13: 978-1936113422.
4. The World of the Cell, 7th edition (2008), Becker, Kleinsmith, Hardin and Bertoni. Benjamin Cummings, ISBN-13: 978-0805393934.
5. The Cell: A Molecular Approach, 6th edition (2013), Cooper and Hausman; Sinauer Associates, Inc. ISBN-13: 978-1605351551.
6. DNA Replication, 2nd edition (2005), Arthur Kornberg; University Science Books ISBN-13: 978-1891389443.

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Syllabus of B.Sc. Microbiology under NEP

SUBJECT TITLE: BIOINFORMATICS (THEORY)
SUBJECT CODE: - BSMB-ID-503
SEMESTER – V, TOTAL HOURS: 60 CREDITS: 4

Course Objectives:

1. The objective of the course is learning and understanding the detailed developments and applications of the field of Bioinformatics in diverse area of biological research.
2. The course generally focuses on genomics, proteomics and computational biology studies and their relevance on research platforms.

Total Number of Hrs.: 60		**Theory**	**Practical**	**Tutorial**
Credits		3	1	-
Hrs/Week		3	2	-
SCHEME OF EXAMINATION				
Total marks: 150				
Theory:100		**Practical:50**		
Final Exam (SEE)	**Internal Assessment (CT+TA)**	**Final Exam (SEE)**	**Internal Assessment (CT+TA/PR)**	
75	**25**	**37**	**13**	

Unit 1 (10 Hours)

Introduction to Bioinformatics, NCBI, Protein Data Bank, PubMed, GenBank, EMBL, and data retrieval. Enzymes structure-function relationship and the basis of structure-based drug design.

Unit 2. (8 Hours)

European Bioinformatics Institute database search; Understanding EXPASY server; ESPript, European Molecular Biology server. Visualization software like PyMOL and others.

Unit 3. (10 Hours)

Introduction to Sequence comparison, global and multiple sequence alignment, Multiple sequence alignment using FASTA, Sequence alignment using CLUSTALW, BLAST, and advanced BLAST.

Unit 4. (**7 Hours)**

Introduction of Homology modeling, homology modeling using various tools such as MODELLER and Phyre-2, etc. Fold Recognition, Ab-initio Method, Protein folding. Classification family of proteins and fold.

Unit 5. (10 Hours)

Introduction to 3-dimensional protein structure, superposition of molecules, Molecular Docking of Protein with small molecules and nucleotides, Molecular Dynamics of Protein, and Concepts of Force Field.

SUBJECT TITLE: BIOINFORMATICS (PRACTICAL)
SUBJECT CODE: - BSMB-ID-503-P CREDITS: 1 TOTAL HOURS: 30

1. Introduction to different operating systems - UNIX, LINUX and Windows.
2. Introduction to bioinformatics databases (any three): NCBI/PDB/DDBJ, Uniprot, PDB.
3. Sequence retrieval using BLAST.
4. Sequence alignment & phylogenetic analysis using clustalW & phylip.
5. Picking out a given gene from genomes using Genscan or other softwares (promoter region identification, repeat in genome, ORF prediction). Gene finding tools (Glimmer, ENSCAN), Primer designing, Genscan/Genetool.
6. Protein structure prediction: primary structure analysis, secondary structure prediction using psipred,homology modeling using Swissmodel. Molecular visualization using jmol, Protein structure modelevaluation (PROCHECK).
7. Prediction of different features of a functional gene.

Suggested reading:

1. Higgins, D. and Taylor, W., "Bioinformatics – Sequence, Structure and Databanks", Oxford University Press. 2003
2. Lacroix, Z. and Critchlow, T., "Bioinformatics – Managing Scientific Data", Morgan Kaufmann Publishers. 2003
3. Bourne, E., P. and Weissig H., "Structural Bioinformatics" John Wiley and Sons. 2003
4. Campbell, A.M., and Heyer, I.J., "Discovering Genomics, Proteomics and bioinformatics"' Benjamin Cummings. 2003
5. Mount D.W., "Bioinformatics – Sequence and Genome Analysis" Cold Spring Harbor Lab. Press. 2001
6. Pevsner, J., "Bioinformatics and Functional Genomics"' John Wiley & Sons. 2003

University of Patanjali, Haridwar

Syllabus of B.Sc. Microbiology under NEP

COURSE DETAILS
SUBJECT TITLE: BIOPROCESS TECHNOLOGY (THEORY)
SUBJECT CODE: BSMB-AE-504
SEMESTER-V TOTAL HOURS: 45 CREDITS: 4

Course Objectives:

1. To acquaint students with technical and biological aspect of microbial utilisation for production of metabolites

Course Outcomes: After completion of this course, student will be able to

1. Designing of bioreactors and control necessary for maximising production.
2. Select and optimise media for maximum production of microbial metabolites.
3. Designing of protocols for strain improvement and separation of molecules after fermentation process

Total Number of Hrs. : 45		**Theory**	**Practical**	**Tutorial**
Credits		**3**	**1**	**-**
Hrs/Week		**3**	**2**	**-**
SCHEME OF EXAMINATION				
Total marks: 150				
Theory:100		**Practical:50**		
Final Exam (SEE)	**Internal Assessment (CT+TA)**	**Final Exam (SEE)**	**Internal Assessment (CT+TA/PR)**	
75	**25**	**37**	**13**	

UNIT I (10 Hours)

Introduction to bioprocess technology. Range of bioprocess technology and its chronological development. Basic principle components of fermentation technology. Types of microbial culture and its growth kinetics– Batch, Fed batch and Continuous culture.

UNIT II (10 Hours)

Design of bioprocess vessels- Significance of Impeller, Baffles, Sparger; Types of culture/production vessels- Airlift; Cyclone Column; Packed Tower and their application in production processes. Principles of upstream processing – Media preparation, Inoculum development and sterilization.

UNIT III (10 Hours)

Introduction to oxygen requirement in bioprocess; mass transfer coefficient; factors affecting KLa. Bioprocess measurement and control system with special reference to computer aided process control.

UNIT IV (15 Hours)

Introduction to downstream processing, product recovery and purification. Effluent treatment. Microbial production of ethanol, amylase, lactic acid and Single Cell Proteins.

BSMB-AE-504-P BIOPROCESS TECHNOLOGY PRACTICALS

Duration 30Hours Credit-1

1. Isolation and Preservation (Agar plate, Slant, Glycerol stock) of economically important strain of microorganisms.
2. Bacterial growth curve.
3. Effect of media supplements on growth of microorganisms and production of metabolite
4. Calculation of thermal death point (TDP) of a microbial sample.
5. Production and analysis of ethanol.
6. Production and analysis of amylase.
7. Production and analysis of lactic acid.
8. Isolation of industrially important microorganism from natural resource.
9. Immobilisation of enzyme.
10. Display of fermenter/bioreactor design

Suggested Reading :

1. Industrial Microbiology by L.E. Casida 2022 2nd Ed.
2. *Industrial Microbiology text book Edition*: *3rd (2017)* ;by Wulf *Crueger*, Anneliese *Crueger*, K.R. Aneja
3. Stanbury PF, Whitaker A and Hall SJ. (2016). Principles of Fermentation Technology. 3rd edition, Elsevier Science Ltd

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Syllabus of B.Sc. Microbiology under NEP

Core Course
COURSE DETAILS
SUBJECT TITLE: MICROBIAL DIAGNOSTIC AND HEALTH CLINIC (THEORY)
SUBJECT CODE: - BSMB-SE-505
SEMESTER – V

CREDITS: 4

Course Objective:
1. It aims to equip students with the knowledge and skills to accurately identify pathogenic microorganisms from clinical samples, interpret the results, and contribute to the diagnosis and management of infectious diseases within a healthcare setting.
2. Be competent in microbiological techniques.
3. Establish good laboratory techniques in hospital and in the community in the fields of Bacteriology, Virology, Mycology, and Parasitology & Immunology.
4. Conduct experimental research having a significant bearing on human health
5. Plan, execute, analyse & present the research work in medical microbiology.

Interact with allied Department by rendering services to advanced laboratory investigations**.**

Course Outcome:
CO1: Acquire skills in conducting collaborative research in the field of Microbiology and Allied Sciences.

CO2: They are also imparted training in teaching methods in the subject which may enable them to take up teaching assignments in Medical /Dental Colleges/Degree Institutes.

CO3: Must be able to demonstrate to the students how the knowledge of Microbiology can be used in variety of clinical settings to solve diagnostic problems.

	Theory	**Practical**	**Tutorial**
Credits	**3**	**1**	**-**
Hrs/Week	**3**	**2**	**-**
SCHEME OF EXAMINATION			
Total marks: 150			
Theory:100		**Practical:50**	
Final Exam (SEE)	**Internal Assessment (CT+TA)**	**Final Exam (SEE)**	**Internal Assessment (CT+TA/PR)**
75	**25**	**37**	**13**

Unit 1 (7 **hrs)**

Importance of diagnosis of diseases Bacterial, Viral, Fungal and Protozoan Diseases of various human body systems, Disease associated clinical samples for diagnosis.

Unit 2 (8 **hrs)**
Collection of Clinical Samples How to collect clinical samples (oral cavity, throat, skin, Blood, CSF, urine and faeces) and precautions required. Method of transport of clinical Samples to laboratory and storage.

Unit 3 (**10 hrs)**

Direct microscopic examination and culture. Examination of sample by staining - Gram stain, Ziehl-Neelson staining for tuberculosis, Giemsa stained thin blood film for malaria Preparation and use of culture media - Blood agar, Chocolate agar, Lowenstein-Jensen medium, Mac Conkey agar, Distinct colony properties of various bacterial pathogens.

Unit 4: (**10 hrs)**

Serological and Molecular Methods Serological Methods - Agglutination, ELISA, immune fluorescence, Nucleic acid based methods - PCR, Nucleic acid probe

Unit 5: (**7 hrs)**

Kits for rapid Detection of Pathogens Typhoid, Dengue and HIV, Swine flu

Unit 6: (**8 hrs)**

Testing for Antibiotic sensitivity in Bacteria Importance, Determination of resistance/sensitivity of bacteria using disc diffusion method, Determination of minimal inhibitory concentration (MIC) of an antibiotic by serial double dilution method.

MICROBIAL DIAGNOSIS IN HEALTH CLINICS Subject Code: BSMB-SE-505

1. Collection transport and processing of any one of the following clinical specimens (Blood/ Urine/ Stool/Sputum). Receipts, Labelling, recording and dispatching clinical specimens.
2. Isolation of bacteria in pure culture and Antibiotic sensitivity by Kirby-Bauer method.
3. Determination of minimal inhibitory concentration
4. Identification of common bacteria (E.coli, Staphylococcus aureus and Streptococcus sps) by studying their morphology, cultural character, Biochemical reactions, and other tests.
5. Maintenance and preservation of stock culture.
6. Isolation of bacterial flora of skin by swab method.
7. Study of various stages of malaria parasite in RBCs using permanent mounts.
8. Identify bacteria (E. coli, Pseudomonas, Staphylococcus, Bacillus) using laboratory strains on the basis of cultural, morphological and biochemical characteristics: IMViC, urease production and catalase tests
9. Peripheral smear staining
10. Absolute eosinophil count

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COURSE DETAILS
SUBJECT TITLE: INTERNSHIP/ REVIEW PAPER/ INDUSTRIAL VISIT
SUBJECT CODE: - BSMB-VA-506
SEMESTER – V CREDIT: 2

1. Here Students will go to Patanjali wellness centre and/or Yoggram for internship or Patanjali Herbal Park at Padartha or some relevant industry for industrial visit 2. After that they have to prepare a project report and submit to the department 3. It will be assessed by a departmental committee and evaluated accordingly.

Else they can write a review paper supervised by a departmental teacher. It will be assessed by a departmental committee and evaluated.

6TH SEMESTER

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Core Course
COURSE DETAILS
SUBJECT TITLE: ADVANCES IN MICROBIOLOGY (THEORY)
SUBJECT CODE: - BSMB-MJ-601
SEMESTER – VI

CREDITS: 4

Course Objective: Understand metagenomic approach to address non culturable microbes. Case study to understand synthetic biology and networking of biological systems

Course Outcome:
Outline the idea of genome evolution and metagenomics
Relate host pathogen relationship, HGT through evolution
Estimate metagenomic DNA through practical process

	Theory	Practical	Tutorial
Credits	**3**	**1**	**-**
Hrs/Week	**3**	**2**	**-**
SCHEME OF EXAMINATION			
Total marks: 150			
Theory:100		**Practical:50**	
Final Exam (SEE)	**Internal Assessment (CT+TA)**	**Final Exam (SEE)**	**Internal Assessment (CT+TA/PR)**
75	**25**	**37**	**13**

Unit 1 Evolution of Microbial Genomes (15 Periods)

Salient features of sequenced microbial genomes, core genome pool, flexible genome pool and concept of pan genome, Horizontal gene transfer (HGT), Evolution of bacterial virulence - Genomic islands, Pathogenicity islands (PAI) and their characteristics.

Unit 2 Metagenomics (15 Periods)

Brief history and development of metagenomics, Understanding bacterial diversity using metagenomics approach, Prospecting genes of biotechnological importance using metagenomics Basic knowledge of viral metagenome, metatranscriptomics, metaproteomics and metabolomics.

Unit 3 Molecular Basis of Host-Microbe Interactions (15 Periods)

Epiphytic fitness and its mechanism in plant pathogens, Hypersensitive response (HR) to plant pathogens and its mechanism, Type three secretion systems (TTSS) of plant and animal pathogens, Biofilms: types of microorganisms, molecular aspects and significance in environment, health care, virulence and antimicrobial resistance.

Unit 4 Systems and Synthetic Biology (15 Periods)

Networking in biological systems, Quorum sensing in bacteria, Co-ordinated regulation of bacterial virulence factors, Basics of synthesis of poliovirus in laboratory, Future implications of synthetic biology with respect to bacteria and viruses

Practical **BSMB-MJ-601-P**

1. Extraction of metagenomic DNA from soil
2. Understand the impediments in extracting metagenomic DNA from soil
3. PCR amplification of metagenomic DNA using universal 16s ribosomal gene primers
4. Case study to understand how the poliovirus genome was synthesized in the laboratory
5. Case study to understand how networking of metabolic pathways in bacteria takes place

Suggested Readings

- Fraser CM, Read TD and Nelson KE. Microbial Genomes, 2004, Humana Press
- Miller RV and Day MJ. Microbial Evolution- Gene establishment, survival and exchange, 2004, ASM Press
- Bull AT. Microbial Diversity and Bioprospecting, 2004, ASM Press
- Sangdun C. Introduction to Systems Biology, 2007, Humana Press
- Klipp E, Liebermeister W. Systems Biology – A Textbook, 2009, Wiley –VCH Verlag
- Caetano-Anolles G. Evolutionary Genomics and Systems Biology, 2010, John Wiley and Sons
- Madigan MT, Martink JM, Dunlap PV and Clark DP (2014) Brook's Biology of Microorganisms, 14th edition, Pearson-Bej

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Core Course
COURSE DETAILS
SUBJECT TITLE: HAEMATOLOGY (THEORY)
SUBJECT CODE: - BSMB-MN-602
SEMESTER – VI

CREDITS: 4

Course Objective: To train students in field of Clinical haematology. The program is designed to give the resident a comprehensive training in clinical and laboratory haematology.

Course Outcome:

- Perform independently different laboratory haematological investigations used to diagnose haematological disorders.
- Supervise the activities of the clinical/laboratory services

Total Number of Hrs.: 60		**Theory**	**Practical**	**Tutorial**
Credits		3	1	-
Hrs/Week		3	2	-
SCHEME OF EXAMINATION				
Total marks: 150				
Theory:100		**Practical:50**		
Final Exam (SEE)	**Internal Assessment (CT+TA)**	**Final Exam (SEE)**	**Internal Assessment (CT+TA/PR)**	
75	**25**	**37**	**13**	

Unit - I Blood: definition, characters, composition. Collection of blood – capillary blood: from adults and infants, examinations employed. Venous blood: from adults and infants, examinations employed – Anticoagulants: definition – type: Wintrobes, EDTA, heparin, citrate, concentration, examinations, advantages and disadvantages.

Unit - II Counting of blood cells: Neubauer counting chamber – total RBC count: diluting fluids, normal values – total WBC count: diluting fluids, normal values differential leucocyte count: granulocyte and agranulocytes, morphology and function, staining technique – Platelet count: morphological characters and functions, haemoglobin: composition and normal values, haemoglobin estimation.

Unit - III Coagulation mechanism: factors, bleeding time, clotting time. Haematological indices: packed cell volume. Erythrocyte sedimentation: principle – determination: introbes, Westegren method – advantages and disadvantages – factors affecting the process.

Unit - IV Preparation of stains and staining techniques: Wright stain, Leishman's stain, Giemsa's stain, Fields stain, peroxidase stain. Examination of blood smear – peripheral smear report – size, colour and shape. Blood parasites: malarial parasite and microfilaria.

Unit - V ABO Grouping: History, slide and tube technique, Rh typing: slide and tube technique, Coombs test: direct and indirect method, donor screening – cross matching, collection of blood, preservation and storage.

Text Books

1. Maheswari N. (2008) Clinical Pathology, Haematology and Blood Banking (for DMLT students) 2 nd Edn. Jaypee Brothers Medical Publishers.

2. Hoffbrand A.V. and Moss P.A.H. (2015) Hoffbrand's Essential Haematology, 7 th Edn. Wiley.

3. Godkar P.B. and Godkar D.P. (2013) Textbook Medical Laboratory Technology Vol-I and II, Bhalani Publishing House. B.Sc. Appl Microbiology CBCS (2017-18 onwards) Page 53 of 56 DSE – 9B APMB 365P Practicals – XXI:

HAEMATOLOGY PRACTICAL (1 credit) BSMB-MN-602-P

1. Collection of blood – finger prick, venous blood.
2. Hb estimation, RBC count, estimation of packed cell volume, total WBC count and absolute eosinophil count.
3. Staining of blood smears and differential count of WBC.
4. Platelet count by various methods.
5. Erythrocyte sedimentation rate by various methods.
6. Preparation of reagents for coagulant studies.
7. Preparation of anticoagulant fluids.
8. Coomb's test.

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SUBJECT TITLE: IPR & BIOSAFETYAND BIOETHICS (THEORY)
SUBJECT CODE: - BSMB-ID-603
SEMESTER – VI, TOTAL HOURS: 45 CREDITS: 4
Course Objectives:

1. To introduce basic concepts of ethics and safety that is essential for Life Science Labs.
2. To understand the procedures involved in protection of Intellectual property.
3. To give an insight into different treaties signed. To gain knowledge about patent filing.

Course Outcome:

1. Gain Knowledge of working principles in a laboratory taking all safety measures, handling of live cultures, disposal of infectious waste, care of the equipment requiring safety audit.
2. Get an insight into Biosafety guidelines and Analyse and Manage the Risks involved with GMOs.
3. Understand about different treaties, rights and duties of Patent owner

Total Number of Hrs.: 45		**Theory**	**Practical**	**Tutorial**
Credits		3	0	-
Hrs/Week		3	0	-
SCHEME OF EXAMINATION				
Total marks: 100				
Theory: 100		**Practical: 50**		
Final Exam (SEE)	**Internal Assessment (CT+TA)**	**Final Exam (SEE)**	**Internal Assessment (CT+TA/PR)**	
75	**25**	**00**	**00**	

Unit 1 No of Hours: 5

Biosafety: Introduction; biosafety issues in biotechnology; Biological Safety Cabinets & their types; Primary Containment for Biohazards; Biosafety Levels of Specific Microorganisms, AERB/RSD/RES guidelines for using radioisotopes in laboratories and precautions

Unit 2 No of Hours: 10

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

Unit 3 No of Hours: 10

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

Unit 4 No of Hours: 10

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 5 No of Hours: 10

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 & Brine conventions; Patent Co-operation Treaty (PCT); Indian Patent Act 1970 & recent amendments.

Suggested reading:

1. Bare Act, 2024.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. (2022). Indian Patents Law, Taxmann, Allied Services (p) Ltd.
4. Singh K K (2015). Biotechnology and Intelectual Property Rights: Legal and Social Implications, Springer India.

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COURSE DETAILS

SUBJECT TITLE: Recombinant DNA Technology

SUBJECT CODE: - BSMB-AE-604

SEMESTER – VI

CREDITS: 3+1=4

Course Objectives:

1. Recombinant DNA Technology refers to the process of manipulating the characteristics and functions of the original genes of an organism.
2. The objective of this process is to introduce new physiological and physical features or characteristics. The students will learn the mechanism of introducing genes from one organism into the other and the potential implications of doing so.

Course Outcomes:

CO1: To understand and remember, the importance of various vectors and enzymes used in rDNA Technology.

CO2: To understand and apply skills in the production of transgenic organisms.

	Theory	Practical	Tutorial
Credits	**3**	**1**	**-**
Hrs/Week	**3**	**2**	**-**
SCHEME OF EXAMINATION			
Total marks: 150			
Theory:100		**Practical:50**	
Final Exam (SEE)	**Internal Assessment (CT+TA)**	**Final Exam (SEE)**	**Internal Assessment (CT+TA/PR)**
75	**25**	**37**	**13**

Unit: 1 Introduction to genetic engineering (**10 hrs)**

Why gene cloning and DNA analysis is important? Molecular tools and applications-restriction enzymes, Restriction and modification system, restriction mapping. ligases, polymerases, alkaline phosphatase. Gene Recombination and Gene transfer: Vectors Systems (plasmids, λ phage biology and its vectors, M13 phage and its vectors, cosmid, phagemid, artificial chromosomes, transformation, microinjection, electroporation.

Unit: 2 Enzymes and vectors used in rDNA technology (**10 hrs)**

Enzymes used in rDNA technology: Ligases, Reverse Transcriptase (RTase). Restriction endonucleases: Types of restriction endonucleases, Nomenclature, Recognition sequences,

Cleavage patterns, Frequency of recognition sites, Modification of cut ends (Linkers and Adaptors)., Exonucleases, Polymerases., DNA modifying enzymes: Alkaline phosphatase, Poly nucleotide kinase, Terminal deoxy nucleotidyl transferase. Cloning vectors: Properties of a good vector, Nomenclature of plasmid cloning vectors. · Plasmids- Size and copy number. Classification of plasmids: Stringent plasmids, Relaxed plasmids, Resistance or R plasmids, Col plasmids, Degradative plasmids, Virulence plasmids, Ti plasmids. PBR322, PUC18-, Expression vectors, phages- λ genetic map, insertional and replacement vectors, cloning experiment with λ based vectors. Yeast vectors (shuttle vectors): 2μm plasmid, YEps, YRps, YCps, YAC.

Unit: 3 Isolation and purification of DNA (**10 hrs)**

Isolation and purification of DNA from bacteria, plants, animals and soil. Preparation and comparison of genomic and cDNA library, different strategies of gene cloning, linkers, adapters and homopolymer tailing, screening of recombinants: gene inactivation and blue white selection, Southern and Northern hybridization. Gene identification: Nucleic acid hybridization, immuno screening, functional complementation, DNA sequencing.

Unit: 4 Gene expression (**10 hrs)**

Expression vectors with respect to different promoters (lac, tac, T5, T7, lamda), signal sequences (omp), tags (His, GST, MBP and IMPACT), selection of host with respect to promoter, Processing of recombinant proteins: soluble proteins, inclusion body, Protein refolding, Therapeutic products produced by genetic engineering-blood proteins, human hormones, immune modulators and vaccines (one example each).

Unit: 5 PCR and its Applications (**10 hrs)**

Principle and applications of Polymerase chain reaction (PCR), primer-design, and RT-(Reverse transcription) PCR. Random and site-directed mutagenesis, PCR based cloning, Reporter assay, RNase protection assay, DNA fingerprinting, application of genetic engineering in animals and plants, Safety measures and regulations for recombinant work.

References:

1. Brown, T. A. (2006). Gene cloning and DNA analysis (5th ed.). Oxford, UK.: Blackwell Publishing.

2. Clark, D. P. & Pazdernik, N. J. (2009). Biotechnology- applying the genetic revolution. USA: Elsevier Academic Press.

3. Glick, B. R., & Pasternak, J. J (2003). Molecular biotechnology- principles and applications of recombinant DNA. Washington: ASM Press.

4. Primrose, S. B., & Twyman, R. M. (2006). Principles of Gene Manipulation and Genomics (7th ed.). Oxford, U.K.: Blackwell Publishing.

5. Sambrook, J., Fritsch, E. F., & Maniatis, T. (2001). Molecular cloning- a laboratory manual (3rd ed.). Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press.

BSMB-AE-604-P Recombinant DNA Technology Practical

1. Isolation of chromosomal DNA from plant cells
2. Qualitative and quantitative analysis of DNA using spectrophotometer
3. Plasmid DNA isolation
4. Restriction digestion of DNA
5. Making competent cells
6. Transformation of competent cells.
7. Replica plating and Blue white selection
8. Southern blotting
9. Demonstration of PCR

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COURSE DETAILS

SUBJECT TITLE: DISSERTATAION WORK/ RESEARCH PAPER

SUBJECT CODE: - BSMB-SE-605

SEMESTER – VI

CREDIT: 3

Here students have to write a standard research paper under the supervision of a teacher. Finally the paper will be presented by the student before the departmental committee for evaluation.

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SUBJECT TITLE: BIOMATERIALS (THEORY)
SUBJECT CODE: - BSMB-VA-606
SEMESTER- VI, TOTAL HOURS: 30 CREDITS: 3
Course objectives:

1. To understand the basics of nanoscience and technology.
2. To understand the various process techniques available for biomaterials.
3. The application of nanotechnology in various fields such as biomedicine, Tissue Replacement Implants and Acute Wound Healing etc.
4.

Total Number of Hrs.: 60		**Theory**	**Practical**	**Tutorial**
Credits		2	1	-
Hrs/Week		2	2	-
SCHEME OF EXAMINATION				
Total marks: 150				
Theory:100		**Practical:50**		
Final Exam (SEE)	**Internal Assessment (CT+TA)**	**Final Exam (SEE)**	**Internal Assessment (CT+TA/PR)**	
75	**25**	**37**	**13**	

Unit 1: Introduction to biomaterials [20HRS]
Classification, Chemistry and characterization of biomaterials. The state of the art of biomaterials and the challenges. Disciplines involved in biomaterials science and the path from a need to a manufactured medical device. Material selection requirements for biomaterials – metals, composites, ceramics and polymers. Tissue environment of the implanted biomaterial: unit cell processes. Tissue responses to implants. Nano-materials: fullerenes, carbon nano-tubes, Nano-membranes. Synthesis of biomaterials, Characterization of chemical, physical, mechanical properties, visco-elasticity, end group analysis, determination of molecular weight of a polymer.

Unit 2: Biocompatibility [10HRS]
Biocompatibility of Biomaterials, wound-healing process, body response to implants, blood compatibility. Tests to assess biocompatibility of a polymer, modifications to improve biocompatibility. Reactions of biomaterials with cellular and extra cellular components.

Unit 3: Modified Biomaterials [10HRS]
Bio degradative biomaterials, bioactive polymers and biosynthetic polymers, inert biomaterials, genetically engineered biomaterials.

Unit 4: Applications of Biomaterials [20HRS]

Tissue Replacement Implants, Acute Wound Healing, Blood Clotting, Chronic Wound Healing and Foreign Body Response. Soft-tissue replacements, sutures, surgical tapes, adhesive, percutaneous and skin implants, maxillofacial augmentation, blood interfacing implants, hard tissue replacement implants, internal fracture fixation devices, and joint replacements. Artificial Organs Artificial Hearts, Prosthetic cardiac Valves, Limb prostheses, Externally Powered limbs, prostheses, Dental Implants, and Other applications. Liposomes, hydrogels and Nanomaterials in drug delivery. Biomaterials in diagnostics and bioanalytical techniques.

SUBJECT TITLE: BIOMATERIALS (PRACTICAL)
SUBJECT CODE: - BSMB-VA-606-P CREDITS: 1 TOTAL HOURS: 30

1. Understand and follow guidelines regarding biological safety and maintain a laboratory notebook that follows the guidelines given in class. Prepare a laboratory report
2. Demonstrate aseptic cell culture techniques
3. Perform transformation into a bacterial cell
4. Describe and demonstrate basic concepts and examples of biomedical signal and
5. image processing, biomaterials, biomechanics, and cellular and molecular biotechnology
6. Perform literature search
7. Prepare a scientific poster
8. Collect, analyse, and interpret physiological measurements
9. Visit to a R&D section of a leading Pharmaceutical company/ surgical theatre of Hospital. Prepare a laboratory report.

Suggested Readings

1. Sujata V. Bhat, Biomaterials, 2nd edition, Narosa Publishing House, New Delhi, 2006.
2. Buddy D. Ratner, B. D. Ratner, Allan S. Hoffman, Biomaterials Science: An Introduction to Materials in Medicine, 2nd Edition (2004) Publisher: Academic Press.
3. Fred W.Billmeyer, Text book of Polymer Science. 3 rd edition John Wiley and Sons publications. 4. Basic & Clinical Pharmacology, 10th ed B.G. Kat sung, McGraw-Hill 2007