JSS MAHAVIDYAPEETA

JSS COLLEGE FOR WOMEN (Autonomous)
Saraswathipuram, Mysuru-570009

(Affiliated to **University of Mysore:** Reaccrediated by **NAAC** with **A+ Grade)**

MICROBIOLOGY SYLLABUS

CBCS and CAGP Pattern

For Undergraduate Course

Syllabus, Course Structure, Scheme of Examination, Question Paper Pattern for the I B.Sc Microbiology combination with effect from the academic year 2021 onwards…

JSS College for Women (Autonomous), Saraswathipuram, Mysuru-570009
Curriculum Structure for the Undergraduate Degree Program
BSc (Basic/Hons.)

Structure and Scheme of DSC in B.Sc Microbiology:

Sem	Core Course	Title of the Paper	No. of Credits			Total Credits	Maximum Marks in Theory and Practical Examinations(C3) / IA (C1+C2)			
			L	T	P		Theory C3	IA C1+C2	Pract. C3	IA C1+C2
I	DSC-1	General Microbiology	4	-	2	6	60	40	25	25
II	DSC-2	Microbial Biochemistry and Physiology	4	-	2	6	60	40	25	25
III	DSC-3	Microbial diversity	4	-	2	6	60	40	25	25
IV	DSC-4	Microbial Enzymology and Metabolism	4	-	2	6	60	40	25	25
V	DSC-5	Microbial genetics and Molecular biology	4	-	2	6	60	40	25	25
	DSC-6	Immunology and Medical microbiology	4	-	2	6	60	40	25	25
VI	DSC-7	Food and Dairy Microbiology	4	-	2	6	60	40	25	25
	DSC-8	Industrial Microbiology and Bioprocess Technology	4	-	2	6	60	40	25	25
VII	DSC-9	Microbial Genetic Engineering	4	-	2	6	60	40	25	25
	DSC-10	Environmental and Agricultural Microbiology	4	-	2	6	60	40	25	25
VIII	DSC-11	Pharmaceutical and Forensic Microbiology	4	-	2	6	60	40	25	25
	DSC-12	Biosafety, Bioethics and IPR	4	-	2	6	60	40	25	25

Note:
Internal Assessments Components for (C1+C2) include Theory Tests, Assignments, Viva-voce, Practical Tests, Practical Record, Educational Visit Report …

BSc Microbiology (Basic/Hons.)
Semester 1

Title of the Courses:

Course 1: ***DSC-1T,*** *General Microbiology*		***Course 2:*** ***OE 1 a-*** *Microbial Technology for Human Welfare* ***OE 1 b-*** *Introduction to Microbiology and Microbial Diversity*	
Number of Theory Credits	Number of lecture hours/semester	Number of Theory Credits	Number of lecture hours/semester
4	**56**	**3**	**42**

BSc Microbiology (Basic/Hons.)
Semester 2

Title of the Courses:

Course 1: ***DSC-2T,*** *Microbial Biochemistry and Physiology*		***Course 2:*** ***OE- 2a,*** *Environmental and Sanitary Microbiology* ***OE- 2b,***	
Number of Theory Credits	Number of lecture hours/semester	Number of Theory Credits	Number of lecture hours/semester
4	**56**	**3**	**42**

BSc Microbiology (Basic/Hons.)
Semester 1

Content of Course 1: Theory: DSC-1T, General Microbiology	**56Hrs**
Unit-1: Historical development of Microbiology, Origin of microorganisms, Scope of Microbiology and Major contributions:	**14Hrs**
Historical development of microbiology- Theory of Biogenesis and Abiogenesis. Fossil evidences of microorganisms. Origin of life, primitive cells and evolution of microorganisms. Scope and Branches of Microbiology. Contributions of Antony Von Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister Edward Jenner, Alexander Fleming, Elie Metchnikoff, Dmitri Iwanovsky, Martinus Beijerinck, and Sergei Winogradsky.	
Unit-2: Staining Techniques and Microscopy:	**14Hrs**
A. Nature and Types of stains, principles, mechanism and methods of staining- Simple and Differential-Gram staining. Structural staining- capsule, flagella, endospore, inclusion bodies.	05Hrs
B. Microscopy- Principles of Microscopy- Resolving Power, Numerical Aperture and Limit of Resolution. Working principle, construction mode of operation and applications/uses of Simple, Compound microscopes and Electron microscopes- Bright field, Dark field, Phase contrast, Fluorescence microscope, TEM and SEM. Preparation of specimen for electron microscopic studies -Fixation, Embedding, Ultra-thin Sectioning, Negative staining, Shadow Casting, and Freeze Etching. Advantages and limitations of TEM and SEM.	09Hrs
Unit – 3: Types, structure, organisation and reproduction of Prokaryotic and Eukaryotic microorganism:	**14Hrs**
A. Overview of Prokaryotic Cell Structure: Size, shape, arrangement. Diagram of Prokaryotic cell organisation, cell wall structure of Gram positive and negative bacteria, cell membrane; Bacterial and Archaeal, Cytoplasmic matrix- Cytoskeleton, ribosome, inclusion granules: Composition and function. Nuclear Materials – Bacterial chromosomes structure. Extra Chromosomal materials. Components external to cell wall- capsule, slime, s-layer, pili, fimbriae, flagella; structure, motility, chemotaxis. Bacterial Endospore - Examples of spore forming organisms, habitats, function, formation and germination. Reproduction in bacteria and bacterial cell cycle.	09Hrs
B. Overview of eukaryotic cell structure: General structure and types of cells; External cell coverings and cell membrane. Structure and function of Cytoplasmic matrix- cytoskeleton: Structure and function; single Membrane organelles- Endoplasmic reticulum, Golgi complex, Lysosomes, Vesicles and Ribosomes; Double Membrane organelles- Nucleus, Mitochondrion and Chloroplast: Structure and Functions; Peroxisomes; Organelles of motility- Structure and movement of flagella and cilia.	05Hrs
Unit-4: Sterilization Techniques, Microbial Culture Media and Culture Techniques:	**14Hrs**
A. Physical methods: Principle, Construction, Mode of Action & Application of the following: Heat: Dry heat- Hot air oven, Incinerator, Moist heat- Autoclave, Arnold sterilizer Filtration: Bacterial filters: Depth filters - Seitz, Sintered glass, Porcelain & Diatomaceous Earth Filter Membrane filter: Membrane Filter Apparatus, HEPA filter - Laminar Air Flow System Radiation treatment: UV rays, γ-rays and Cathode rays. Chemical methods: Disinfectants, Antiseptics, Sanitizers, Microbistatics, Microbicides (Bactericide, Fungicide, Virucide & Sporicide) Practical Applications and Mode of action of – Alcohols, Aldehydes, Halogens, Phenols, Peroxides, Heavy metals, Soaps and Detergents(QUATS) Gaseous Sterilants- Ethylene oxide, β-Propiolactone.	07Hrs

B. General culture media ingredient- Peptone, Beef extract, Yeast extract, Agar. Types of Culture Media –Natural media, Simple media, Semi-synthetic media, Synthetic media, Differential media, Selective media, Indicator media, Enriched media, Enrichment media, Transport media, Sugar media, Anaerobic media, Assay media. Pure cultures and Colony characteristics, Serial dilution. Pure culture techniques: Pour plate, Spread plate, Streak plate, Stab culture, Agar slant culture and Point inoculation. Cultivation of Anaerobic bacteria- GasPak method. Preservation and Maintenance of pure culture: Subculture, Overlaying with Mineral Oil, Lyophilization, Cryopreservation methods (Freezing technique) Culture Collection Centres – ATCC and MTCC (a brief account)	07Hrs

Course 1: Practical: DSC-1P, General Microbiology

1. a. Microbiological laboratory standards and safety protocols.
   Laboratory safety: General rules and regulations- Good Laboratory Practices (GLP).
1. b. Study of Simple & Compound microscopes and their handling including 100x
2. a. Preparation of Stains, Mordant - Methylene Blue, Crystal Violet, Safranine, Nigrosine, Carbol Fuchsin, Malachite Green, Gram's Iodine, Lactophenol Cotton Blue
2. b. Simple staining - Positive staining
3. a. Simple staining - Negative staining
3. b. Differential staining - Gram's staining
4. a. Structural staining – Endospore staining
4. b. Study of bacterial motility by Hanging Drop Method.
5. a. Cleaning and sterilization of glass wares
5. b. Preparation of culture media –Nutrient Agar Medium, Nutrient Broth, Potato Dextrose Agar Medium, Mac Conkey's Agar Medium, MSA Medium, EMB agar medium
6. a. Preparation of Physiological Saline and Serial Dilution Technique
6. b. Culture techniques: Pour Plate, Spread Plate,
7. Culture techniques (Contd.): Streak Plate Stab culture and study of colony characteristics
8. a. Culture techniques (Contd.): Point inoculation, Agar Slant preparation
8. b. Maintenance of pure cultures by paraffin method
9. Demonstration of cultivation of anaerobic bacteria- GasPak method
10. Micrometry: Measurements of microorganisms using Stage and Ocular Micrometer
11. Evaluation of disinfectants- Phenol coefficient test
12. Study Antimicrobial agents: Soaps, Detergents, Phenol, Ethyl alcohol, Iodine.
13. a. Study of Microscopes- Dark Field, Phase Contrast, Stereo Binocular Microscope
13. b. Contributions of Microbiologists as mentioned in theory syllabus
14. Demonstration of laboratory equipment- Autoclave, Pressure cooker, Hot air oven, Incubator, Laminar Air Flow System, Membrane filter apparatus, Inoculating loop & Inoculating needle, Digital Colony Counter.

Text Books / References:

1. General Microbiology 1st Edition, 2020, Linda Bruslind, Oregon State University

2. Prescott, Harley, Klein's Microbiology, J.M. Willey, L.M. Sherwood, C.J. Woolverton, 7th International, edition 2008, McGraw Hill.

3. Foundations in Microbiology, K. P. Talaro, 7th International edition 2009, McGraw Hill.

4. A Textbook of Microbiology, R. C. Dubey and D. K. Maheshwari, 1st edition, 1999, S. Chand & Company Ltd.

5. Brock Biology of Microorganisms, M.T.Madigan, J.M.Martinko, P. V. Dunlap, D. P. Clark- 12th edition, Pearson International edition 2009, Pearson Benjamin Cummings.

6. Microbiology – An Introduction, G. J.Tortora, B. R.Funke, C. L. Case, 10th ed. 2008,Pearson Education.

7. General Microbiology, Stanier, Ingraham et al, 4th and 5th edition 1987, Macmillan education limited.

8. Microbiology- Concepts and Applications, Pelczar Jr,Chan, Krieg, International ed, McGraw Hill.

9. Alexopoulos, C.J., Mims, C.W., and Blackwell, M. 2002. Introductory Mycology. John Wiley and Sons (Asia) Pvt. Ltd. Singapore. 869 pp.

10. Atlas, R.M. 1984. Basic and practical microbiology. Mac Millan Publishers, USA. 987pp.

11. Black, J.G. 2008. Microbiology principles and explorations. 7edn. John Wiley and Sons Inc., New Jersey 846 pp.

12. Pommerville, J.C. Alcamo's Fundamentals of Microbiology. Jones and Bartlett Pub..Sudburry, 835 pp.

13. Schlegel, H.G. 1995.General Microbiology. Cambridge University Press, Cambridge, 655 pp.

14. Toratora, G.J., Funke, B.R. and Case, C.L. 2007. Microbiology 9th ed. Pearson Education Pvt. Ltd., San Francisco. 958pp.

Course 2 : Theory: OE 1T, Microbial Technology for Human Welfare

Course 2 : OE 1T, Microbial Technology for Human Welfare	**42Hrs**
Unit – 1: Food and Fermentation Microbial Technology	**14Hrs**
Fermented Foods – Types, Nutritional Values, Advantages and Health Benefits Prebiotics, Probiotics, Synbiotics and Nutraceutical Foods Fermented Products – Alcoholic and nonalcoholic beverages, fermented dairy products, Fruit fermented drinks	
Unit – 2: Agricultural Microbial Technology	**14Hrs**
Microbial Fertilizers, Microbial Pesticides, Mushroom Cultivation, Biogas Production	
Unit – 3: Pharmaceutical Microbial Technology	**14Hrs**
Microbial Drugs – Types and Development of Drug Resistance Antibiotics – Types, Functions and Antibiotic Therapy Vaccines – Types, Properties, Functions and Schedules	

Course 2: Theory: OE 2T, Introduction to Microbiology and Microbial Diversity

Course 2: OE 2T, Introduction to Microbiology and Microbial Diversity	**42Hrs**
Unit- 1 History of Development of Microbiology and Scope of Microbiology	**14Hrs**
Definition, Development of microbiology as a discipline, golden era of microbiology, relevance of microbiology, Microbiology in different areas- Agriculture, Industry, Dairy, Water, Food, Medical, Air, Soil	
Unit -2 Microbial diversity	**14Hrs**
Study of different groups of microorganisms: Bacteria: occurrence, size, shapes, structure & study of some useful & harmful bacteria(in brief) Fungi: occurrence, structure and study of some useful and harmful fungi(in brief) Algae: occurrence, structure and study of some useful and harmful algae(in brief) Protozoa: occurrence, structure and study of some useful and harmful protozoa(in brief) Viruses: occurrence, size, shapes, structure and study of some useful & harmful viruses(in brief)	
Unit -3 Microorganisms and their Habitats	**14Hrs**
Terrestrial Environment: Soil profile and soil microflora Aquatic Environment: Microflora of fresh water and marine habitats Atmosphere: Aeromicroflora and dispersal of microbes Animal Environment: Microbes in/on human body (Microbiomics) & animal (ruminants) body	

BSc Microbiology (Basic / Hons.)
Semester 2

Content of Course: DSC-2T, Microbial Biochemistry and Physiology	**56Hrs**
Unit-1: Biochemical Concepts.	**14Hrs**
Basic Biochemical Concepts: Major elements of life and their primary characteristics, atomic bonds and molecules – bonding properties of carbon, chemical bonds- covalent and non covalent, Hydrogen bonds and Vander Waal Forces. Biological Solvents: Structure and properties of water molecule, Water as an universal solvent, polarity, hydrophilic and hydrophobic interactions, properties of water, Acids, bases, electrolytes, hydrogen ion concentration, pH, buffers and physiological buffer system, Handerson – Hasselbatch equation.	05Hrs 09Hrs
Unit – 2: Macromolecules – Types, Structure and Properties	**14Hrs**
Carbohydrates: Definition, classification, structure and properties. Amino acids and proteins: Definition, structure, classification and properties of amino acids, Structure and classification of proteins. Lipids and Fats: Definition, classification, structure, properties and importance of lipids. Porphyrins and Vitamins: Definition, structure, properties and importance of chlorophyll, cytochrome and hemoglobin.	
Unit – 3: Microbial Physiology	**14Hrs**
A. Microbial Growth: Definition of growth, Mathematical expression, Growth curve, phases of growth, calculation of generation time and specific growth rate. Synchronous growth, Continuous growth (chemostat and turbidostat), Diauxic growth. Measurement of Growth: Direct Microscopic count - Haemocytometer; Viable count, Membrane filtration; Electronic Counting; Measurement of cell mass;Turbidity measurements-Nephelometer and spectrophotometer techniques; Measurements of cell constituents. Growth Yield (definition of terms). Influence of environmental factors on growth. Microbial growth in natural environments. viable non-culturable organisms. Quorum sensing. **B.** Microbial Nutrition: Microbial nutrients, Classification of organisms based on carbon source, energy source and electron source, Macro and micronutrients. Membrane Transport: Structure and organization of biological membranes, Types of Cellular transport, Passive, Facilitated, Active, Group Translocation, Membrane bound and binding protein transport system, Carrier models, Liposomes, Ion transduction Na K_+, ATPase.	07Hrs 07Hrs
Unit – 4: Microbial Physiology- Bioenergetics, Microbial Respiration, Microbial Photosynthesis	**14Hrs**
A. Bioenergetics: Free energy, Enthalpy, Entropy, Classification of high energy compounds, Oxidation reduction reactions, equilibrium constant, Redox potential, Law of thermodynamics. Microbial Respiration: Respiratory electron transport chain in bacteria, oxidation – reduction reactions, protein translocation, oxidative and substrate level phosphorylation – inhibitors and mechanism, chemiosmotic coupling. Fermentation reactions (homo and hetero) **B.** Microbial Photosynthesis: Light reaction: Light harvesting pigments, Photophosphorylation, CO2 fixation pathways: Calvin cycle, CODH pathway, Reductive TCA pathway.	07Hrs 07Hrs

Course 1: Practicals: DSC-2P, Microbial Biochemistry and Physiology

1. Preparation of Solution: Normal and Molar solutions
2. Calibration of pH meter and determination of pH of natural samples
3. Preparation of Buffer Solutions
4. Qualitative determination and identification of Carbohydrates
5. Qualitative determination and identification of Proteins
6. Qualitative determination and identification of Amino Acids
7. Qualitative determination and identification of Fatty Acids
8. Quantitative estimation of Reducing Sugur by DNS method
9. Quantitative estimation of Proteins by Biuret and Lowry's method
10. Determination of lipid saponification values of fats and iodine number of fatty acids
11. Determination of bacterial growth by spectrophotometric method & calculation of generation time
12. Effect of Temperature and pH on the growth of microorganisms
13. Effect of Temperature and pH on the growth of microorganisms
14. Effect of UV- rays and Oxygen on the growth of microorganisms
15. Demonstration of aerobic and anaerobic respiration in microbes

Text Books / References

1. Cohen, Georges N, 2014, Microbial Biochemistry, Springer Netherlands.
2. Felix Franks, 1993; Protein Biotechnology, Humana Press, New Jersey.
3. Stryer L, 1995; Biochemistry, Freeman and Company, New York.
4. Voet & Voet, 1995; Biochemistry, John Wiley and Sons, New York.
5. Nelson and Cox, 2000; Lehninger Principles of Biochemistry, Elsevier Publ.
6. Harper, 1999; Biochemistry, McGraw Hill, New York.
7. Palmer T. (2001), Biochemistry, Biotechnology and Clinical Chemistry, Harwood Publication, Chichester.
8. Boyer R. (2002), Concepts in Biochemistry 2nd Edition, Brook/ Cole, Australia.
9. Moat A. G., Foster J.W. Spector. (2004), Microbial Physiology 4th Edition Panama Book Distributors.
10. Caldwell, D. R. (1995) – Microbial Physiology and Metabolism. Brown Publishers.
11. Lodish H, T. Baltimore, A. Berck B.L. Zipursky, P. Mastsydaire and J. Darnell. (2004) – Molecular Cell Biology, Scientific American Books, Inc. Newyork.

Course 2: Theory: OE- 2a, Environmental and Sanitary Microbiology

Course 2: OE- 2a, Environmental and Sanitary Microbiology	**42Hrs**
Unit – 1: Soil and Air Microbiology	**14Hrs**
Fermented Foods – Types, Nutritional Values, Advantages and Health Benefits Prebiotics, Probiotics, Synbiotics and Nutraceutical Foods Fermented Products – Alcoholic and non-alcoholic beverages, fermented dairy products, Fruit fermented drinks	
Unit – 2: Water Microbiology	**14Hrs**
Water as a major component of environment. Types, properties and uses of water. Microorganisms of different water bodies. Standard qualities of drinking water	
Unit – 3: Sanitary Microbiology	**14Hrs**
Public health hygiene and communicable diseases. Survey and surveillance of microbial infections. Airborne microbial infections, waterborne microbial infections, Food borne microbial infections. Epidemiology of microbial infections, their detection and control.	

Course 2: Theory: OE 2b, Microbes of Human Health and Welfare

Course 2: OE 2b, Microbes of Human Health and Welfare	**42Hrs**
Unit- 1 Study of some common communicable diseases	**14Hrs**
Bacterial diseases: Cholera Tuberculosis and Typhoid Viral diseases: Ebola, HIV and Corona- Covid 19 Fungal diseases: Mucoromycosis, Dermatomycosis and Candidiosis Protozoal disease: Malaria, Amoebic dysentery and Toxoplasmosis	
Unit -2: Personal and Environmental hygiene	**14Hrs**
Introduction to the Principles and Concepts of Hygiene and Environmental Health Environmental Health Hazards, Personal Hygiene Hygienic Requirements of Foods and Drink Service Establishments Hygienic and Safety Requirements for Food of Animal Origin	
Unit -3 Useful microbes- Microbes in Human welfare	**14Hrs**
Antibiotics and vaccines Microbes and fermentation Microbes as food Microbes in sewage treatment Microbes in production of Biogas Microbes as biofertilizers and biopesticides	

Scheme of Practical Examination

Practical: DSC-1P, General Microbiology

Time: 03 Hours **Max. Marks: 25**

I. Stain the given specimen 'A' by ……..method. Write the principle, procedure and leave the preparation for evaluation. 07 Marks

(Preparation– 2 marks, Principle-1 mark, Procedure– 2 marks, Labelled Diagram- 1mark, Result- 1 mark)

(Simple positive/Direct staining, Negative/Indirect staining, Gram's staining, Endospore staining, Hanging drop method)

II. Demonstrate/perform the experiment 'B'. Write the principle, procedure and interpret the result. 07 Marks

(Demonstration – 3 marks, Principle – 1 mark, Procedure-2 marks and Result – 1 mark)

(Serial Dilution Technique, Pour Plate, Spread Plate, Streak Plate, Stab culture, Point inoculation, Agar Slant preparation, Phenol coefficient test)

III. Micrometry: Measure the size of the given specimen 'C' using stage and ocular micrometer. Write the principle, procedure and result. 5 Marks

(Principle– 1 mark, Procedure – 2 marks, Calibration – 1 mark, Result – 1)

IV. Write critical notes on D, E and F 2x3=6 Marks

(Autoclave, Hot air oven, Incubator, Laminar Air Flow System, Membrane Filter Apparatus, Inoculation loop, Inoculation needle, Digital Colony counter, Dark Field Microscope, Phase Contrast Microscope, Stereo Binocular Microscope, Oil immersion objective, Soaps, Detergents, Phenol, Ethyl alcohol, Iodine, Antony Von Leewenhoek, Edward Jenner, Dmitri Iwanovsky, Louis Pasteur, Robert Koch, Joseph Lister, Elie Metchnikoff, Alexander Fleming)

Question Paper Pattern for Theory Examination

Time: 3 Hours **Max. Marks: 60**

A. Answer the following: **1x5=05 Marks**

1.

2.

3.

4.

5.

B. Answer any FIVE of the following: **3x5=15 Marks**

6.

7.

8.

9.

10.

11.

12.

C. Answer any FOUR of the following: **5x4=20 Marks**

13.

14.

15.

16.

17.

18.

D. Answer any TWO following: **10x2=20 Marks**

19.

20.

21.

22.

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