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UNIVERSITY OF MYSORE

Estd. 1916

Vishwavidyanilaya Karyasoudha
Crawford Hall, Mysuru- 570 005

No.AC2(S)/151/2020-21

Dated: 04.10.2023

Notification

Sub:- Modification Syllabus and Scheme of Examinations Microbiology (UG) (IIIrd & IVth Semester) with effect from the Academic year 2023-24.


Ref:- Decision of Board of Studies in Microbiology (UG) meeting held on 16.09.2023.

The Board of Studies in Microbiology (UG) which met on 16.09.2023 has resolved to recommend and approved the syllabus and scheme of Examinations of Microbiology Programme (IIIrd & IVth Semester) with effect from the Academic year 2023-24.

Pending approval of the Faculty of Science & Technology and Academic Council meetings the above said syllabus and scheme of examinations are hereby notified.

The syllabus and scheme of Examinations contents may be downloaded from the University website i.e., www.uni-mysore.ac.in.

DRAFT APPROVED BY THE REGISTRAR


Deputy Registrar (Academic)
Deputy Registrar (Academic)
University of Mysore
Mysore-570 005

To;

1. All the Principal of affiliated Colleges of University of Mysore, Mysore.
2. The Registrar (Evaluation), University of Mysore, Mysuru.
3. The Chairman, BOS/DOS in Microbiology, Manasagangothri, Mysore.
4. The Director, Distance Education Programme, Moulya Bhavan, Manasagangothri, Mysuru.
5. The Director, PMEB, University of Mysore, Mysore.
6. Director, College Development Council, Manasagangothri, Mysore.
7. The Deputy Registrar/Assistant Registrar/Superintendent, Administrative Branch and Examination Branch, University of Mysore, Mysuru.
8. The PA to Vice-Chancellor/ Registrar/ Registrar (Evaluation), University of Mysore, Mysuru.
9. Office Copy.



UNIVERSITY OF MYSORE

**Curriculum Framework for Undergraduate Programme
in Colleges at University of Mysore, Mysuru**

NATIONAL EDUCATION POLICY 2020

**3rd and 4th Semester Model Syllabus for
B. Sc. in Microbiology**

**Board of Studies in Microbiology
Department of Studies in Microbiology
University of Mysore
Manasagangotri, Mysuru – 570 006**

2023-24 onwards

B. Sc.: Curriculum and Credit Framework for Undergraduate Programme

Sem.	Discipline Specific Courses - Core (DSC), Elective (DSE)(Credits) (L+T+P)	Minor/ Multidisciplinary/Open Elective (OE) Courses(Credits) (L+T+P)	Ability Enhancement Courses (AEC) (Credits)(L+T+P) (Languages)	Skills Enhancement Courses (SEC) (Credits) (L+T+P)/ Value Added Courses (Credits) (L+T+P) (common for all UG Programs)/ Summer Internship.		Total Credits
I	DSC-A1(4), A2(2) DSC-B1(4), B2(2)	OE-1 (3)	L1-1(3), L2-1(3) (4 hrs each)	SEC-1: Digital Fluency (2) (1+0+2)/ Env. Studies (3)	Health, Wellness & Yoga (2) (1+0+2)	25/26
II	DSC-A3(4), A4(2), DSC-B3(4), B4(2)	OE-2 (3)	L1-2(3), L2-2(3) (4 hrs each)	Env. Studies (3)/ SEC-1: Digital Fluency (2)(1+0+2)	Sports/NCC/NSS/R&R(S&G) / Cultural (2) (0+0+4)	26/25
Students exiting the programme after securing 46 credits will be awarded UG Certificate in Disciplines A and B provided they secure 4 credits in work based vocational courses during summer term or internship/Apprenticeship in addition to 6 credits from skill-based courses earned during the first year.						
III	DSC-A5(4), A6(2), DSC-B5(4), B6(2)	OE-3 (3)/ India and Indian Constitution (3)	L1-3(3), L2-3(3) (4 hrs. each)	SEC-2:AI/CyberSecurity/Finan- cial Edu. & Inv. Aw. (2) (1+0+2)	Sports/NCC/NSS/R&R(S&G) /Cultural (2) (0+0+4)/ SEC(2)	25
IV	DSC-A7(4), A8(2), DSC-B7(4), B8(2)	India and Indian Constitution (3) / OE-3(3)	L1-4(3), L2-4(3) (4 hrs. each)	SEC-3: Financial Edu. &Inv. Aw. /AI /Cyber Security (2) (1+0+2)	Sports/NCC/NSS/R&R(S&G) / Cultural (2) (0+0+4)/ SEC (2)	25
Students exiting the programme after securing 92 credits will be awarded UG Diploma in Disciplines A and B provided they secure additional 4 credits in skill based vocational courses offered during first- or second-year summer term.						
V	DSC-A9(4), A10(2), A11(4), A12(2);	DSC-B9(4), B10(2), B11(4),B12(2)		SEC-4: Employability Skills/Cyber Security (3) (2+0+2)		27
VI	DSC-A13(4), A14(2), A15(4), A16(2);	DSC-B13(4), B14(2), B15(4), B16(2)		Internship (2)		26
Students exiting the programme after 3-years will be awarded UG Degree in Disciplines A and B as double majors upon securing 136 credits and satisfying the minimum credit requirements under each category of courses prescribed.						

III and IV Semester Courses for Undergraduate Program in MICROBIOLOGY

Sem. No.	Course Category	Course Code	Course Title	Credits Assigned	Instructional hours per week		Duration of Exam (Hrs.)	Exam/ Evaluation Pattern (Marks)		
					Theory	Practical		IA	Exam	Total
III	DSC	DSC-5T	Microbial diversity	4	4		2 ¹ / ₂	40	60	100
		DSC-6P	Microbial diversity	2		4	3	25	25	50
	OEC	OE-3T	Microbial Entrepreneurship	3	3		2 ¹ / ₂	40	60	100
IV	DSC	DSC-7T	Microbial Enzymology and Metabolism	4	4		2 ¹ / ₂	40	60	100
		DSC-8P	Microbial Enzymology and Metabolism	2		4	3	25	25	50
	OEC	OE-4T	Human Microbiome	2	2		2 ¹ / ₂	20	30	50

MODEL CURRICULUM

Name of the Degree Program: B. Sc. (Basic/Hons.)

Discipline Core: Microbiology

Total Credits for the Program: B. Sc. Basic - 136 and B. Sc. Hons. - 176

Starting year of implementation: 2021-22

Program Outcomes: Competencies need to be acquired by the candidate securing B. Sc. (Basic) or B. Sc. (Hons.)

By the end of the program the students will be able to:

1. Knowledge and understanding of concepts of microbiology and its application in pharma, food, agriculture, beverages, nutraceutical industries.
2. Understand the distribution, morphology and physiology of microorganisms and demonstrate the skills in aseptic handling of microbes including isolation, identification and maintenance.
3. Competent to apply the knowledge gained for conserving the environment and resolving the environmental related issues.
4. Learning and practicing professional skills in handling microbes and contaminants in laboratories and production sectors.
5. Exploring the microbial world and analysing the specific benefits and challenges.
6. Applying the knowledge acquired to undertake studies and identify specific remedial measures for the challenges in health, agriculture, and food sectors.
7. Thorough knowledge and application of good laboratory and good manufacturing practices in microbial quality control.
8. Understanding biochemical and physiological aspects of microbes and developing broader perspective to identify innovative solutions for present and future challenges posed by microbes.
9. Understanding and application of microbial principles in forensic and working knowledge about clinical microbiology.
10. Demonstrate the ability to identify ethical issues related to recombinant DNA technology, GMOs, intellectual property rights, biosafety and biohazards.
11. Demonstrate the ability to identify key questions in microbiological research, optimize research methods, and analyse outcomes by adopting scientific methods, thereby improving the employability.
12. Enhance and demonstrate analytical skills and apply basic computational and statistical techniques in the field of microbiology.

Assessment:

Weightage for assessments (in percentage)

Type of Course	Formative Assessment / IA	Summative Assessment
Theory	40%	60%
Practical	50%	50%
Projects	40%	60%
Experiential Learning (Internships/MOOC/Swayam etc.)	30%	70%

Formative Assessment : 40%	
Assessment Occasion/ type	Weightage in Marks
C1 = IA -1 + Assignments / Visits	10% + 10% = 20% : 20 Marks
C2 = IA -2 + Seminars / Group Discussion	10% + 10 = 20% : 20 Marks
Total	40% : 40 Marks

Total Marks for each course = 100%**Formative Assessment (C1 + C2) = 40%****Semester End Examination (C3) = 60% marks**

B. Sc. Microbiology 3rd Semester

Program name	B. Sc. in MICROBIOLOGY		Semester	III
Course Title	MICROBIAL DIVERSITY (Theory)			
Course Code	DSC-5T	No. of Credits		04
Contact Hours	60 (4 Hrs. per week)	Duration of SEA/Exam (Hrs.)		2 1/2
Formative Assessment Marks	40	Summative Assessment Marks		60

Course Outcomes (COs): At the end of the course the student should be able to;

1. Knowledge about microbes and their diversity.
2. Study, characters, classification and economic importance of Pro-eukaryotic and Eukaryotic microbes.
3. Knowledge about viruses and their diversity.

Content of Course 3: Theory: DSC-5T, Microbial Diversity	60 Hrs.
Unit 1: Biodiversity and Microbial Diversity	15 Hrs.
Concept, definition, and levels of biodiversity. Study and measures of microbial diversity. Major classification systems: Whittaker's five kingdom classification and Carl Woese's three domain classification. Biosystematics: Taxonomic ranks, Nomenclature – ICNP rules. Phenotypic and phylogenetic classification. Classical and molecular characteristic used in microbial taxonomy. Assessing microbial phylogeny- Molecular chronometer and Phylogenetic tree. Numerical and Chemotaxonomy. Ribotyping. Economic values of microbial diversity.	
Unit 2: Diversity of Prokaryotic Microorganisms	15 Hrs.
An overview of Bergey's Manual of Systematic Bacteriology. General characteristics and economic importance; Bacteria- <i>Escherichia coli</i> , <i>Bacillus subtilis</i> , <i>Staphylococcus aureus</i> Archea- Thermophiles- <i>Thermus aquaticus</i> and Halophiles- <i>Halobacteria salinarium</i> Cyanobacteria- <i>Nostoc</i> , <i>Microcystis</i> , <i>Spirulina</i> Actinomycetes: <i>Streptomyces</i> , <i>Nocardia</i> , <i>Frankia</i> Rickettsiae- <i>Rickettsia rickettsi</i> Chlamydiae- <i>Chlamydia trachomatis</i> Spirochaetes- <i>Treponema pallidum</i>	
Unit 3: Diversity of Eukaryotic Microorganisms	15 Hrs.
Fungi: Alexopoulos and Mim's classification. General characteristics, Structure, reproduction and economic importance- <i>Rhizopus</i> , <i>Aspergillus</i> , <i>Agaricus</i> , <i>Fusarium</i> , <i>Saccharomyces</i> . Algae: Fritsch's classification. Occurrence, thallus organization and economic importance <i>Chlorella</i> , <i>Cosmarium</i> , Diatoms, <i>Gracilaria</i> , Lichen-thallus organization and types. Protozoa: Salient features, Classification up to the level of classes. Type study- <i>Euglena</i> , <i>Paramoecium</i> , <i>Trypanosoma</i>	
Unit 4: Diversity of Virus	15 Hrs.

General properties and structure, Isolation and purification of virus.
 Principles of Viral taxonomy- Baltimore and ICTV classification.
 Capsid symmetry- Icosahedral, helical, complex.
 Structure, Replication and Significance of the following:
 Human and Animal viruses: HIV, Corona, Oncogenic virus and H1N1.
 Plants viruses: TMV, Ring spot virus in Tomato
 Microbial viruses: T4 phage, Lambda phage, Cyanophages and Mycophages.
 Subviral particles: Viroids, Virusoids, Satellite virus and Prions.

Pedagogy: Lectures, Seminars, Industry/Institute Visits, Debates, Quiz, Project and Assignments

Formative Assessment for Theory	
Assessment Occasion/ type	Marks
Attendance	10
Seminar	10
Debate/Quiz/Assignment	10
Class test	10
Total	40
Formative Assessment as per guidelines are compulsory	

Course 3: Practical: DSC-6P, Microbial Diversity

Course Title	MICROBIAL DIVERSITY (Practical)		
Course Code	DSC-6P	No. of Credits	02
Contact Hours	60 (4 Hrs. per session)	Duration of SEA/Exam (Hrs.)	03
Formative Assessment Marks	25	Summative Assessment Marks	25

Practical Content

1. Isolation and enumeration of bacteria from soil
2. Isolation and identification of fungi from soil
3. Isolation and characterization of bacteria from air
4. Isolation and identification of fungi from air
5. Isolation and enumeration of bacteria from water
6. Microscopic observation of pond and lake water for cyanobacteria and algae
7. Cultivation of cyanobacteria
8. Cultivation of Actinomycetes
9. Measurement of microbial cell size by Micrometry
10. Study of cyanobacteria – *Nostoc*, *Microcystis*, *Spirulina*
11. Study of Algae – *Chlorella*, Diatoms, Gracilaria
12. Study of Fungi – *Rhizopus*, *Aspergillus*, *Saccharomyces*, *Agaricus*
13. Study of Protozoa – *Paramecium*, *Euglena*
14. Study of HIV, Corona virus and Oncogenic viruses
15. Study of TMV, T4 Phage and Viroids

Pedagogy: Experiential learning, Problem solving, Project

Formative Assessment for Practical	
Assessment Occasion/ type	Marks
Class Records	05
Test	10
Attendance	05
Performance	05
Total	25
Formative Assessment as per guidelines are compulsory	

Text Books / References

1. Brock, T. D. and Madigan, M. T. (1988). *Biology of Microorganisms*, V Edition. Prentice Hall. New Jersey
2. Vashishta, B. R, Sinha A.K and Singh V. P. (2005). *Botany – Fungi*, S. Chand and Company Limited, NewDelhi
3. Black, J. G. (2002). *Microbiology-Principles and Explorations*. John Wiley and Sons, Inc. New York
4. Dimmock, N. J., Easton, A. J., and Leppard, K. N. (2001). *Introduction to Modern Virology*. 5th edn. Blackwell publishing, USA
5. Flint, S. J., Enquist, L. W., Drug, R. M., Racaniello, V. R. and Skalka, A. M. (2000). *Principles of Virology- Molecular Biology, Pathogenesis and Control*. ASM Press, Washington,D.C
6. Prescott, Harley, Klein's *Microbiology*, J. M. Willey, L. M. Sherwood, C. J. Woolverton, (2008) 7th edition, McGraw Hill
7. Kotpal R. L (2008). *Protozoa*, 5th edn. Rastogi Publications, Meerut, New Delhi.
8. Tortora, G. J. Funke, B. R. Case, C. L. (2008). *Microbiology – An Introduction*, 10th edn., PearsonEducation
9. Pelczar, M. J., Chan, E. C. S. and Krieg, N. R. (1993). *Microbiology*. 5th edn. McGraw Hill Book Company.
10. Vashishta, B. R Sinha A. K and Singh V. P. (2005). *Botany - Algae* S. Chand and Company Limited, NewDelhi
11. Alexopoulos, C. J., Mims, C. W., and Blackwell, M. (2002). *Introductory Mycology*. John Wiley and Sons (Asia) Pvt. Ltd. Singapore. 869pp

Course 3: Theory: OE 3T, Microbial Entrepreneurship

Course Outcomes (COs): At the end of the course the student should be able to:

1. Demonstrate Entrepreneurial skills
2. Acquire knowledge industrial Entrepreneurship
3. Acquire knowledge about Healthcare Entrepreneurship

Course 3: Theory: OE 3T, Microbial Entrepreneurship	42Hrs
Unit 1: General Entrepreneurship	14Hrs
Entrepreneurship and microbial entrepreneurship - Introduction and scope, Business development, product marketing, HRD, Bio-safety and Bioethics, IPR and patenting, Government organization/ institutions/ schemes, Opportunities and challenges.	
Unit 2: Industrial Entrepreneurship	14Hrs
Microbiological industries – Types, processes and products, Dairy products, Fermented foods, Bakery and Confectionery, Alcoholic products and Beverages, Enzymes – Industrial production and applications. Biofertilizers and Biopesticides, SCP (Mushroom and <i>Spirulina</i>) etc.	
Unit 3: Healthcare Entrepreneurship	14Hrs
Production and applications: Sanitizers, Antiseptic solutions, Polyphenols (Flavonoids), Alkaloids, Cosmetics, Biopigments and Bioplastics, vaccines, Diagnostic tools and kits.	

Text Books / References

1. Srilakshmi B, (2007). Dietetics. New Age International publishers. New Delhi
2. Srilakshmi B, (2002). Nutrition Science. New Age International publishers. New Delhi
3. Swaminathan M. (2002). Advanced text book on food and Nutrition. Volume I. Bappco
4. Gopalan.C., Ramasastry, B.V., and Balasubramanian, S.C.(2009). Nutritive value of IndianFoods. NIN. ICMR. Hyderabad.
5. Mudambi, S. R. and Rajagopal, M. V. (2008). Fundamentals of Foods, Nutrition & diet therapy by NewAge International Publishers, New Delhi

B. Sc. Microbiology 4th Semester

Program name	B. Sc. in MICROBIOLOGY	Semester	IV
Course Title	MICROBIAL ENZYMOLOGY AND METABOLISM (Theory)		
Course Code	DSC-7T	No. of Credits	04
Contact Hours	60 (4 Hrs. per week)	Duration of SEA/Exam (Hrs.)	2 1/2
Formative Assessment Marks	40	Summative Assessment Marks	60

Course Outcomes (COs): At the end of the course the student should be able to:

1. Differentiating concepts of chemo heterotrophic metabolism and chemo lithotrophic metabolism.
2. Describing the enzyme kinetics, enzyme activity and regulation.
3. Differentiating concepts of aerobic and anaerobic respiration and how these are manifested in the form of different metabolic pathways in microorganisms

Content of Course 4: DSC-7T, Microbial Enzymology and Metabolism	60 Hrs.
Unit 1: Basics of Enzymes	15 Hrs.
<p>Enzymes- Definition, nomenclature and IUB system of classification. Definition of terms: enzyme unit, specific activity and turnover number. Enzyme types with example: exo and endoenzymes, constitutive and induced enzymes, Monomeric, Oligomeric and Multimeric enzymes, Multi-enzyme complex, Isozyme, Lysozyme, Ribozymes, abzymes.</p> <p>Structure of enzyme: Apoenzyme, cofactors, prosthetic group-TPP, coenzyme-NAD. Active site- properties and role. Mechanism of enzyme action. Lock and key hypothesis and Induced Fit hypothesis. Enzyme catalysis: types and factors affecting the enzyme catalysed reaction. Enzyme kinetics- Michaeli's and Menten equation, Lineweaver-Burk plot.</p>	
Unit 2: Enzyme regulation and Microbial enzymes	15 Hrs.
<p>Enzyme inhibition: Reversible- Competitive, non-competitive and uncompetitive inhibition. Irreversible and Feedback inhibition. Enzyme regulation: Allosteric enzyme - general properties, Hill equation. Regulation of multi-enzyme complex- Pyruvate dehydrogenase. Microbial enzymes: source- fungal, bacterial and yeast. Production, Purification and isolation of microbial enzymes. Application of microbial enzymes- Pharmaceutical, Food and Feed industry, Paper and Pulp industry, Leather and Textile industry, Enzymes in cosmetics and detergents. Microbial enzymes as therapeutic agents: Anti-inflammatory, Antibacterial (Enzybiotics, Fibrinolytic enzymes) and Anticancer enzymes, Enzymes as digestive aids.</p>	
Unit 3: Metabolism of Carbohydrates	15 Hrs.
<p>Chemoheterotrophic Metabolism- Sugar degradation pathways i.e. EMP, ED, Pentose phosphate pathway. TCA cycle. Utilization of Lactose, Maltose, Cellulose and Pectin. Fermentation: Concept of linear and branched fermentation pathways. Alcohol fermentation and Pasteur effect, 2, 3-butanediol fermentation, acetate Fermentation. Chemolithotrophic Metabolism: Hydrogen oxidation, Sulphur oxidation, Iron oxidation.</p>	

Anaerobic respiration with special reference to assimilatory sulphate reduction.

Unit 4: Metabolism of Nitrogen, Amino acids, Lipids and Carbon compounds

15 Hrs.

Nitrogen metabolism: Biological nitrogen fixation- nodulation in leguminous plants, Nitrogenase, leghaemoglobin, Ammonia assimilation. Assimilatory nitrate reduction, dissimilatory nitrate reduction, denitrification.

Biosynthesis of non-essential amino acids and Amino acid degradation.

Biosynthesis of long chain fatty acids- plamitate and lipid degradation (beta oxidation).

Metabolism of carbon compounds: Methylo trophs- Oxidation of methane, methanol, methylamines. Carbon assimilation in methylo trophic bacteria. Methanogens. Acetic acid bacteria- Ethanol oxidation and sugar alcohol oxidation.

Pedagogy: Lectures, Seminars, Industry/Institute Visits, Debates, Quiz, Project and Assignments

Formative Assessment for Theory	
Assessment Occasion/ type	Marks
Attendance	10
Seminar	10
Debate/Quiz/Assignment	10
Class test	10
Total	40
Formative Assessment as per guidelines are compulsory	

Course 4: Practical: DSC-8P, Microbial Enzymology and Metabolism

Course Title	MICROBIAL ENZYMOLOGY AND METABOLISM (Practical)		
Course Code	DSC-8P	No. of Credits	02
Contact Hours	60 (4 Hrs. per session)	Duration of SEA/Exam (Hrs.)	03
Formative Assessment Marks	25	Summative Assessment Marks	25

Practical Content

1. Sugar fermentation tests for bacteria
2. Separation of amino acids by paper chromatography
3. Identification of fatty acids and other lipids by TLC
4. Screening of fungi for cellulose degradation
5. Starch hydrolysis.
6. Isolation and characterisation of proteolytic bacteria from soil
7. Gelatin hydrolysis
8. Screening of fungi for invertase
9. Enzyme immobilization by Alginate method
10. Microscopic examination of root nodules
11. Demonstration of Ammonification
12. Demonstration of Nitrification – Nitrite and Nitrate
13. Demonstration of Denitrification
14. Demonstration of lipolytic activity
15. Demonstration of citric acid production
16. Study of photographs/models: Sulphur oxidation, Iron oxidation, Legume-*Rhizobium* system, Nitrogenase complex, Ribozymes, Abzymes, Lock and key hypothesis, Induced fit model, Competitive inhibition, Non-competitive inhibition, Allosteric enzymes, Feedback inhibition

Pedagogy: Experiential learning, Problem solving, Project

Formative Assessment for Practical	
Assessment Occasion/ type	Marks
Class Records	05
Test	10
Attendance	05
Performance	05
Total	25
Formative Assessment as per guidelines are compulsory	

Text Books / References

1. Philipp, G. Manual of Methods for General Bacteriology.
2. David T. Plummer. An Introduction to Practical Biochemistry
3. Wood, W. B., Wilson, J.H., Benbow, R.M. and Hood, L.E. (1981). Biochemistry- A Problem Approach, 2nd ed., The Benjamin/ Cummings Pub.co
4. Segel, I.R. (2004). Biochemical calculations, 2nd ed., John Wiley and Sons
5. Irwin H. Segel. Biochemical Calculations, , 2nd Edition John Wiley & Sons

Course 4: Theory: OE- 4T, Human Microbiome

Course Outcomes (COs): At the end of the course the student should be able to:

1. Articulate a deeper understanding on biological complexities of human microbiome.
2. Understand broader goals of biological anthropology.
3. Compare and contrast the microbiome of different human body sites and impact human health promotion

Course 4: Theory: OE- 4T, Human Microbiome	42Hrs
Unit 1: Introduction to Microbiome	14Hrs
Evolution of microbial life on Earth, Symbiosis host-bacteria. Microbial association with plants and animals, Symbiotic and parasitic, Normal human microbiota and their role in health. Microbiomes other than digestive system.	
Unit 2: Microbiomes and Human health	14Hrs
Microbiome in early life, Nutritional modulation of the gut microbiome for metabolic health- role of gut microbiomes in human obesity, human type 2 diabetes and longevity. Probiotics- Criteria for probiotics, Development of Probiotics for animal and human use; Pre and synbiotics. Functional foods-health claims and benefits, Development of functional foods.	
Unit 3: Culturing of Microbes from Microbiomes	14Hrs
Culturing organisms of interest from the microbiome: bacterial, archaeal, fungal, and yeast, viral. Extracting whole genomes from the microbiome to study microbiome diversity Microbiomes and diseases: Microbiome and disease risks: The gut microbiome and host immunity, bacteriocins and other antibacterials. Human microbiome research in nutrition	

Text Books / References

1. Angela E Douglas, (2018). Fundamentals of Microbiome Science: How Microbes Shape Animal Biology. Princeton University Press. 248pp.
2. Giulia Enders and Jill Enders, (2018). Gut: The Inside Story of Our Body's Most Underrated Organ (Revised Edition). Greystone Books, 304pp.
3. Emeran Mayer, (2018). The Mind-Gut Connection: How the Hidden Conversation within our bodies impacts our mood, our choices, and our overall Health. Harper Wave, 336pp.
4. Edward Ishiguro, Natasha Haskey and Kristina Campbell, (2018). Gut Microbiota. 1st edition. 2008pp.
5. Natalia V Beloborodova, (2021). Human Microbiome. IntechOpen, 166pp. Gregory, P. H. (1961). The Microbiology of the atmosphere. Interscience Publishers, New York.

SCHEME OF PRACTICAL EXAMINATION

III SEMESTER (NEP)

PRACTICAL III: Microbial Diversity

Time: 03 Hours

Max. Marks: 25

1. Demonstrate the experiment A by giving principle and procedure. Record the result.

08 marks

(Measurement of microbial cell size by Micrometry / Isolation and characterization of bacteria from air by exposure plate method / Isolation and enumeration of bacteria from soil or water by serial dilution method / Isolation and identification fungi from air by exposure plate method / Isolation and identification of fungi from soil by serial dilution method)

(Demonstration – 2M, Principle – 2M, Procedure – 2M, Result – 2M)

2. Prepare a temporary mount of the given material B and identify the organism with labelled diagram and significance. Leave the preparation for evaluation

05 marks

(Staining of Fungi / Algae / Cyanobacteria)

(Preparation – 1 M, Identification – 1M, Diagram and significance – 3M)

3. Write critical notes on C, D, E and F

4x2 = 08 marks

(Permanent slides or photographs of Paramecium, Euglena, TMV, Corona, T4 phage, Oncogenic virus, Actinomycetes, *Aspergillus*, *Rhizopus*, *Sachharomyces*, *Agaricus*, *Chlorella*, Diatoms, *Gracilaria*, *Nostoc*, *Microcystis*, *Spirulina*)

4. Viva-voce

04 marks

**SCHEME OF PRACTICAL EXAMINATION
IV SEMESTER (NEP)**

PRACTICAL IV: Microbial Enzymology and Metabolism

Time: 3 hrs.

Max. Marks: 25

1. Demonstrate the experiment A giving principle and procedure. Record the result.

08 marks

(Separation of amino acids by paper chromatography / Screening of fungi for invertase / Enzyme immobilization by Alginate method / Screening of fungi for cellulose degradation / Microscopic examination of root nodules / Identification of fatty acids and other lipids by TLC)

(Demonstration – 2M, Principle – 2M, Procedure – 2M, Result – 2M)

2. Conduct the given biochemical test B giving principle and procedure. Write the significance.

05 marks

(Gelatin hydrolysis / Starch hydrolysis / Demonstration of Ammonification / Nitrification / Denitrification / Lipolytic activity / Sugar fermentation / Demonstration of citric acid production)

(Demonstration – 2M, Principle and Procedure – 2M, Significance – 1M)

3. Write critical notes on C, D, E and F

4x2 = 08 marks

(Study of photographs/models: Sulphur oxidation, Iron oxidation, Legume-*Rhizobium* system, Nitrogenase complex, Ribozymes, Abzymes, Lock and key hypothesis, Induced fit model, Competitive inhibition, Non-competitive inhibition, Allosteric enzymes, Feedback inhibition)

4. Viva-voce

04 marks