B.Sc. Microbiology Semester-III & IV

Semester-wise Details

Second Year

Year / Semester	Serial Number, Code & Nomenclature of Paper				Duration of Exam	Teaching Hrs/Week & Credit			Distribution of Marks			Min. Pass Marks	
	Number	Code		Nomenclature		L	P	C	Inter-nal Assess.	Sem. Assess.	Total Marks	Internal Assess.	Sem. Assess.
II Year **III Semester**	3.1	BMB09	DCC	Microbial Ecology	3 Hrs	4	--	4	30	70	100	12	28
	3.2	BMB10	DCC	Microbial Physiology and Metabolism	3 Hrs	4	--	4	30	70	100	12	28
	3.3	BMB11	DCC	Medical Microbiology	3 Hrs	4	--	4	30	70	100	12	28
	3.4	BMB12	DCC	Practical-III	6 Hrs	--	12	6	--	150	150	--	75
	3.7	GEC	GEC	Computer Application	1.5 Hrs	2	---	2	---	50	50	--	20
	Semester Total					**14**	**12**	**20**	**90**	**410**	**500**	**--**	
IIIYear **IV Semester**	4.1	BMB13	DCC	Genetic Engineering & rDNA technology	3 Hrs	4	--	4	30	70	100	12	28
	4.2	BMB14	DCC	Food & Dairy Microbiology	3 Hrs	4	--	4	30	70	100	12	28
	4.3	BMB15	DCC	Environmental Microbiology	3 Hrs	4	--	4	30	70	100	12	28
	4.4	BMB16	DCC	Practical-IV	6 Hrs	--	12	6	--	150	150	--	75
	4.7	GEC	GEC	Environment Science	1.5 Hrs	2	---	2	---	50	50	--	20
	Semester Total					**14**	**12**	**20**	**90**	**410**	**500**	**--**	
	SecondYear TOTAL					**28**	**24**	**40**	**180**	**820**	**1000**	**--**	
Option for exit with Diploma in Microbiology (80 credits score)													

Assessment Pattern:

The assessment of the students shall be divided into two parts in which first part is continuous assessment or internal assessment or mid-term assessment (30% weightage of the maximum marks) and second part is semester assessment or external assessment or end-term assessment (70% weightage of the maximum marks). Assessment pattern and distribution of maximum marks is summarized as given below:

(i) Continuous or Internal or Mid Term Assessment:

(a) The continuous or internal or mid-term assessment (30% weightage of the maximum marks) for each theory paper shall be taken by the faculty members of the respective Departments during each semester. There will be three internal assessment tests (*i.e.*first internal assessment test or first mid-term test and second internal assessment test or second mid-term test and third internal assessment test) each of 10% weightage of maximum marks of each theory paper. Each internal assessment shall be of one hour duration for theory paper and shall be taken according to academic calendar which will be notified by the Department / University.

(b) For practical papers, there will be no continuous or internal or mid-term assessment. There will be only one external or semester or end-term assessment (100% weightage of maximum marks).

(ii) Semester or External or End Term Assessment:

(a) The semester or external or end-term assessment (70% weightage of the maximum marks) shall be three hours duration to each theory paper and twelve hours duration (spread over two days with 6 hours per day) for each practical paper and shall be taken by the University at the end of each semester.

(b) The syllabus for each theory paper is divided into five independent units and question paper for each theory will be divided into three sections as mentioned below:

Section-A *will carry 20 marks with one compulsory question comprising ten short answer type questions taking two questions from each unit. Each question shall be of two marks.*

Section-B *will carry 50 marks with equally divided into five long answer type questions. Paper setter shall be advised to set two questions from each unit and students are instructed to attempt five questions by selecting one question from each unit.*

(c) The syllabus of practical paper is divided according to main streams of Biotechnology. Marks shall be awarded on the basis of major & minor experiments, spotting, viva-voce, practical record, regularity factor, lab skills, maintain cleanness of workplace, *etc.*

Question Paper Pattern:

(A) Continuous or Internal or Mid Term Assessment:

30% weightage of Maximum Marks (30 Marks out of 100 Maximum Marks).

(i) Continuous or Internal or Mid Term Assessment:

Format

Department of .....
College / University .....
Address.....

First Internal Assessment Test 20… - 20….

Class	**:**	**Max. Marks**	**: 10 Marks**
Semester	**:**	**Duration of Exam.**	**:**
Subject	**:**	**Date of Examination**	**:**
Paper	**:**	**Name of Teacher**	**:**

Note: All questions are compulsory and marks are given at the end of the each question. Two or three sub-divisions may be given in the question.

Q. No. 1. ……..
or……4 Marks
Q. No. 2. ……..
or……3 Marks
Q. No. 3. ……..
or……3 Marks

(B) Semester or External or End Term Assessment:

70% weightage of Max Marks (*i.e.*70 Marks out of 100 Max Marks).

Duration of Examination: 3 Hours **Max. Marks: 70**

Note*: The syllabus is divided into five independent units and question paper will be divided into three sections.*

- ***Section-A*** *will carry 20 marks with one compulsory question comprising ten short answer type questions taking two questions from each unit. Each question shall be of one mark.*
- ***Section-B*** *will carry 50 marks with equally divided into five long answer type questions . Paper setter shall be advised to set two questions from each unit and students are instructed to attempt five questions by selecting one question from each unit.*

SECTION-A

Q. 1.

Unit-I

(i) …… **2 Mark**
(ii) …… **2 Mark**

Unit-II

(iii) …… **2 Mark**
(iv) …… **2 Mark**

Unit-II

(v) …… **2 Mark**
(vi) …… **2 Mark**

Unit-IV

(vii) …… **2 Mark**
(viii) ..…… **2 Mark**

Unit-V

(ix) …… **2 Mark**

(x) …… **2 Mark**

SECTION-B

Unit-I

Q. 2. ……..…… **10 Marks**
or …….....…… **10Marks**

Unit-II

Q. 3. ……..……**10 Marks**
or ……..…..…… **10 Marks**

Unit-III

Q. 4. ……..…… **10 Marks**
or ……..…..…… **10 Marks**

Unit-IV

Q. 5. . ……..…..…… **10 Marks**
or ……..…….. **10Marks**

Unit-V

Q. 6. ……....…… **10Marks**
or ……..…….… **10 Marks**

Practical Examinations:

Continuous or Internal or Mid Term Assessment: *Not applicable in practical.*
External or Semester or End Term Assessment:
Duration of Exam : 6 Hours
Maximum Marks : 150 Marks*
Distribution of Maximum Marks:

S. No.	Name of Exercise	Marks

1.	Exercise No. 1 : Major Experiment	12
2.	Exercise No. 2 : Major Experiment	12
3.	Exercise No. 3 : Major Experiment	12
4.	Exercise No. 4 : Minor Experiment	10
5.	Exercise No. 5 : Minor Experiment	10
6.	Exercise No. 6 : Minor Experiment	10
7.	Exercise No. 7: Preparation	8
8.	Exercise No. 8: Preparation	8
9.	Exercise No. 9: Preparation	8
10.	Exercise No. 10 : Spotting Experiment(5 x 3= 15spots)	30
11.	Record (5x3)	15
12.	Viva-voce	15
Total Marks		**150**

Semester Third

Paper 3.1. BMB – 09Microbial Ecology

Course Type : Core **Credits:4**

Duration :3 hrs

Continuous/Internal/Assessment : 30 Marks
Semester Assessment : 70 Marks

Note*: The syllabus is divided into five independent units and question paper will be divided into two sections.*

- ***Section-A*** *will carry 20 marks with one compulsory question comprising ten short answer type questions taking two questions from each unit. Each question shall be of two marks.*
- ***Section-B*** *will carry 50 marks with equally divided into five long answer type questions (answer about in 400 words). Paper setter shall be advised to set two questions from each unit and students are instructed to attempt five questions by selecting one question from each unit.*

UNIT-I

Ecology - Development of ecology as a science, its significance and the history and development of microbial ecology. Definition and concept of ecology. Scope of ecology. Autecology and synecology. Ecosystems, components of ecosystems, levels of organizations, trophic levels, food chains, food webs, ecological pyramids and energetics.

UNIT-II

Biogeochemical Aspects of microbial ecology: Carbon cycle: Microbial degradation of cellulose, hemicelluloses, lignin and chitin.Nitrogen cycle: Nitrogen fixation, ammonification, nitrification, denitrification and nitrate reduction.Phosphorus cycle: Phosphate immobilization and solubilisation.Sulphur cycle: Microbes involved in sulphur cycle, Sulphur oxidation, sulphur reduction. Other elemental cycles: Iron and manganese.

UNIT-III

Micro organisms and their natural habitats:
Terrestrial environment - Soil, physical and chemical properties of soil, Humus and humification.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.Extreme Habitats: Extremophiles: Microbes thriving at high & low temperatures, pH, high hydrostatic & osmotic pressures, salinity, & low nutrient levels.

UNIT-IV

Micro organisms and their natural habitats:
Aquatic environment - Fresh and marine water microflora, eutrophication, biomagnifications.
Atmospheric environment - Aero microflora, droplet nuclei, biofilms.
Extreme environment - Habitats and microbes:Thermophiles, barophiles, halophiles, osmophiles, acidophiles.

UNIT-V

Biological interaction:
Microbe - Microbe interaction - Symbiosis, synergism, neutralism, commensalism, mutualism, amensalism, competition, parasitism, predation. MicrobePlant interaction –Symbiotic and non symbiotic, introduction of biological nitrogen fixation
Microbe - Animal interaction - Rumen micro biology: Microbes in ruminants, nematophagus fungi

and symbiotic luminescent bacteria.

References:

1. Alexander, M. 1997. Introduction to soil Microbiology. John Wiley and sons Inc., New York.
2. Environmental microbiology: principles and applications by Patrick K. Jjemba.Science publisher, 2004.
3. Environmental microbiology by P. D. Sharma, Alpha Sciences international, 2005.
4. Environmental microbiology by Ian Papper and Charles Gerba, Elsevir Press.
5. Environmental microbiology by Rose Environmental microbiology Vol III-IV, 1999
6. Atlas R M and Bartha, 1993. Microbial Ecology, Bejaminn Cummings Publishing Co.Redwood City CA

Semester Third

Paper 3.2BMB 10- Microbial Physiology and Metabolism

Course Type : Core **Credits:4**

Duration :3 hrs
Continuous/Internal/Assessment : 30 Marks
Semester Assessment : 70 Marks

Note*: The syllabus is divided into five independent units and question paper will be divided into two sections.*

- ***Section-A*** *will carry 20 marks with one compulsory question comprising ten short answer type questions taking two questions from each unit. Each question shall be of two marks.*
- ***Section-B*** *will carry 50 marks with equally divided into five long answer type questions (answer about in 400 words). Paper setter shall be advised to set two questions from each unit and students are instructed to attempt five questions by selecting one question from each unit.*

UNIT-I

Definitions of growth, Batch culture, Continuous culture, generation time and specific growth rate. Microbial growth in response to environment -Temperature (psychrophiles, mesophiles, thermophiles,extremophiles, thermodurics, psychrotrophs), pH (acidophiles, alkaliphiles), solute and water activity (halophiles,xerophiles, osmophilic), Oxygen (aerobic, anaerobic, microaerophilic, facultative aerobe, facultative anaerobe),barophilic.

UNIT-II

Microbial growth in response to nutrition and energy – Autotroph/Phototroph, heterotrophy, Chemolithoautotroph, Chemolithoheterotroph, Chemoheterotroph, Chemolithotroph, photolithoautotroph, Photoorganoheterotroph.
Passive and facilitated diffusion. Primary and secondary active transport, concept of uniport, symport and antiport, Group translocation.

UNIT-III

Concept of aerobic respiration, anaerobic respiration and fermentation. Sugar degradation pathways i.e. EMP, ED, Pentose phosphate pathway TCA cycle.
Electron transport chain: components of respiratory chain, comparison of mitochondrial and bacterial ETC, electron transport phosphorylation.

UNIT-IV

Anaerobic respiration with special reference to dissimilatory nitrate reduction (Denitrification; nitrate /nitrite and nitrate/ammonia respiration; fermentative nitrate reduction).
Fermentation - Alcohol fermentation and Pasteur effect; Lactate fermentation (homofermentative and heterofermentative pathways), concept of linear and branched fermentation pathways.

UNIT-V

Introduction to aerobic and anaerobic chemolithotrophy with an example of each. Hydrogen oxidation (definition and reaction) and methanogenesis (definition and reaction).
Introduction to phototrophic metabolism - groups of phototrophic microorganisms, Anoxygenic*vs.* oxygenic photosynthesis with reference to photosynthesis in green bacteria and cyanobacteria
Ammonia assimilation. Assimilatory nitrate reduction.

References:

1. Madigan MT, and Martinko JM (2014). Brock Biology of Microorganisms. 14th edition. Prentice Hall International Inc.
2. Moat AG and Foster JW. (2002). Microbial Physiology. 4th edition. John Wiley & Sons.
3. Reddy SR and Reddy SM. (2005). Microbial Physiology. Scientific Publishers India.
4. Gottschalk G. (1986). Bacterial Metabolism. 2nd edition. Springer Verlag.
6. Stanier RY, Ingrahm JI, Wheelis ML and Painter PR. (1987). General Microbiology. 5th edition, McMillan Press.
7. Willey JM, Sherwood LM, and Woolverton CJ. (2013). Prescott's Microbiology. 9th edition. McGraw Hill Higher Education.

Semester Third

Paper 3.3. BMB 11- Medical Microbiology

Course Type : Core **Credits:4**

Duration :3 hrs

Continuous/Internal/Assessment : 30 Marks
Semester Assessment : 70 Marks

Note*: The syllabus is divided into five independent units and question paper will be divided into two sections.*

- ***Section-A*** *will carry 20 marks with one compulsory question comprising ten short answer type questions taking two questions from each unit. Each question shall be of two marks.*
- ***Section-B*** *will carry 50 marks with equally divided into five long answer type questions (answer about in 400 words). Paper setter shall be advised to set two questions from each unit and students are instructed to attempt five questions by selecting one question from each unit.*

UNIT- I

Normal microflora of the human body: Importance of normal microflora, normal microflora of skin,throat, gastrointestinal tract, urogenital tract. Host pathogen interaction,Infection and disease-Types of infections, Various sources of Infection, Carriers of infection.Definitions of MID, ID50, MLD, LD50, bacteremia, Septicemia, contagious epidemic, endemic, pandemic, sporadic and prosodesmic diseases. Epizootic and enzootic.

UNIT-II

Bacterial diseases: Causative agents, Symptoms, mode of transmission, prophylaxis and control: Respiratory Diseases: *Streptococcus pyogenes, Haemophilus influenzae, Mycobacterium* tuberculosis. Gastrointestinal Diseases: *Escherichia coli, Salmonella typhi, Vibrio cholerae, Helicobacter pylori. Others: Staphylococcus aureus, Bacillus anthracis, Clostridium tetani, Treponema pallidum.*

UNIT-III

Viral diseases: Causative agents, Symptoms, mode of transmission, prophylaxis and control: Polio, Hepatitis, Small pox, Chicken pox, Mumps, AIDS Herpes simplex, SARS, Ebola Chikungunya.
Protozoan diseases: Causative agents, Symptoms, mode of transmission, prophylaxis and control: Malaria, Kala-azar.

UNIT-IV

Fungal diseases: Causative agent, transmission, symptoms and prevention:
Cutaneous mycoses: Tineapedis (Athlete's foot), Helminthic diseases; Pinworm disease, Round worm, hook worm, liverfluke.
Opportunistic mycoses: Candidiasis.

UNIT-V

Diseases of human beings:Diagnosis, symptoms, toxic components, etiology.
Sample collection, transport and diagnosis: Collection, transport and culturing of clinical samples.
Antimicrobial agents: Modes of action with one example of each Antibacterial agents, Antifungal agents, Antiviral agents.

References:

1. Ananthanarayan R. and Paniker C.K.J. (2009) Textbook of Microbiology. 8th edition, University Press Publication
2. Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. (2013) Jawetz, Melnick and
   Adelberg's Medical Microbiology. 26th edition. McGraw Hill Publication
3. Goering R., Dockrell H., Zuckerman M. and Wakelin D. (2007) Mims' Medical Microbiology. 4th
   edition. Elsevier
4. Willey JM, Sherwood LM, and Woolverton CJ. (2013) Prescott, Harley and Klein's Microbiology. 9th edition. McGraw Hill Higher Education
5. Madigan MT, Martinko JM, Dunlap PV and Clark DP. (2014). Brock Biology of Microorganisms.14th edition. Pearson International Edition.

Paper 3.4. BMB 12PRACTICALS III

1. To study the bacterial ecology in fresh water environment
2. To study the microbial diversity of soil.
3. To study the microbial ecology of the rhizosphere and determination of rhizospheric effect
4. Demonstration of nitrate reduction
5. Demonstration of decarboxylation of amino acid.
6. Isolation of photosynthetic bacteria by column method
7. To study and plot the growth curve of *E coli* using turbidometric method and to calculate specific growth rate and generation time.
8. To study and plot the growth curve of *Aspergillusniger* by radial growth measurements.
9. To study the effect of pH on the growth of *E. coli*
10. To study the effect of temperature of *Aspergillusniger* by dry weight method.
11. Demonstration of the thermal death time and decimal reduction time of *E. coli*.
12. Demonstration of alcoholic fermentation.
13. Effect of different nitrogen sources on growth of *E. coli.*
14. Effect of different carbon sources on growth of *E. coli*.
15. Identify bacteria, *E. coli, Salmonella, Pseudomonas, Staphylococcus, Bacillus* (any three)on the basis of cultural, morphological and biochemical characteristics: IMViC, TSI, nitrate reduction, urease production and catalase tests.
16. Study of composition and use of important differential media for identification of bacteria: EMB Agar, Mannitol salt agar, Deoxycholate citrate agar, TCBS.
17. Study of bacterial flora of skin by swab method.
18. Perform antibacterial sensitivity by Kirby-Bauer method.
19. Study symptoms of the diseases with the help of photographs: Polio, anthrax, herpes, chicken pox, AIDS, dermatomycoses (ring worms).
20. Study of various stages of Malarial parasite in RBCs using permanent mounts/Photomicrographs.

Semester Fourth

Paper 4.1. BMB 13 Genetic Engineering and r-DNA Technology

Course Type : Core **Credits:4**

Duration :3 hrs

Continuous/Internal/Assessment : 30 Marks
Semester Assessment : 70 Marks

Note*: The syllabus is divided into five independent units and question paper will be divided into two sections.*

- ***Section-A*** *will carry 20 marks with one compulsory question comprising ten short answer type questions taking two questions from each unit. Each question shall be of two marks.*
- ***Section-B*** *will carry 50 marks with equally divided into five long answer type questions (answer about in 400 words). Paper setter shall be advised to set two questions from each unit and students are instructed to attempt five questions by selecting one question from each unit.*

UNIT- I

Introduction of genetic engineering. Methods of DNA, RNA and Protein analysis: Agarose gel electrophoresis, Southern - and Northern- blotting techniques, dot blot, SDS-PAGE and Western blotting.

DNA modifying enzymes and their applications: restriction enzymes, DNA polymerases. Terminaldeoxynucleotidyltransferase, kinases & phosphatases, and DNA ligases.

UNIT-II

Polymerase chain reaction. C-DNA synthesis and cloning: mRNA enrichment, reverse transcription, Linkers, adapters, blunt end ligation, homopolymer tailing. Genomic and cDNA libraries: Preparation and uses, Genome sequencing.

DNA Sequencing: traditional and automated sequencing.

UNIT-III

Cloning Vectors: Plasmid vectors(pBR and pUC), Bacteriophage(Lambda and M13), Cosmids, BACs, YACs. Cloning and expression of foreign genes in prokaryotes (*E.coli*). Cloning and expression of foreign genes in eukaryotes(eg. yeast). Gene tagging.

Selection of recombinant : Direct & Indirect method.

UNIT-IV

Gene transfer-microinjection, electroporation, microprojectile, shot gun method ultra -sonication, Liposome fusion, microlasers. Use of *Agrobacterium tumefaciens*and*A.rhizogenes*, Tiplasmids,Application of molecular cloning.

UNIT-V

Products of recombinant DNA technology: Products of human therapeutic interest (insulin, hGH), antisense molecules, recombinant vaccines. Gene therapy.

Transgenic plants: Bt transgenic (cotton, brinjal), flavrsavrtomato, golden rice.

Protein engineering. Transgenic animals(cow, sheep, poultry, fish).

References:

1. Glick B.R and Pasternak J.J. (2010), Molecular Biotechnology: Principles and Applications of Recombinant DNA. ASM Press.
2. Brown TA. (2010). Gene Cloning and DNA Analysis. 6th edition. Blackwell Publishing, Oxford,
3. Brown TA. (2007). Genomes-3. Garland Science Publishers.
4. Nigel Halford. (2006). Plant Biotechnology: Current and Future Applications of Genetically Modified Crops.WileyDreamtech India.
5. Bernard, R.G. and Jack, J.P. (2003). Molecular Biotechnology: principles and application of recombinant DNA. ASM Press.
6. Primrose, S. B. Twyman, P.M. and Old, R. W. (2001) Principles of gene manipulation(6th Ed.). Black well publishers.
7. Sambrose and Russell. (2001), Molecular Cloning. 3 volumes. CSH Lab Pres. Hellen, K., Adrian, M. and John W. (2000). Recombinant DNA and Biotechnology.
8. Old and Primrose. (1994). Principles of Gene Manipulation, Blackwell Scientific Publications

Semester Fourth

Paper 4.2. BMB-14Food & Dairy Microbiology

Course Type : Core **Credits:4**

Duration :3 hrs

Continuous/Internal/Assessment : 30 Marks
Semester Assessment : 70 Marks

Note*: The syllabus is divided into five independent units and question paper will be divided into two sections.*

- ***Section-A*** *will carry 20 marks with one compulsory question comprising ten short answer type questions taking two questions from each unit. Each question shall be of two marks.*
- ***Section-B*** *will carry 50 marks with equally divided into five long answer type questions (answer about in 400 words). Paper setter shall be advised to set two questions from each unit and students are instructed to attempt five questions by selecting one question from each unit.*

UNIT- I

Food as a substrate for microorganisms,Microbial flora of foods: Milk, fruits, vegetables, meat, eggs, Factors affecting kinds and numbers of microorganisms, intrinsic and extrinsic factors, Sources of contamination.

UNIT- II

Food poisoning, Microorganisms involved, sources of contamination, Role of *Staphylococcus aureus, Clostridium botulinium*and*Salmonella*spp.,Molds as poisoning agents.
Microbial Spoilage of food,causes of spoilage, Biochemical changes caused by microbes.

UNIT-III

Spoilage of milk and milk products, fruits, vegetables, eggs, meat. Spoilage of canned foods
Preservation of food and Milk: General principles and Methods of preservation:Physical methods - high temperature, low temperature, irradiation, aseptic packaging.
Chemical methods - salt, sugar, benzoates, citric acid, ethylene oxide, nitrate and nitrite.
Food sanitation and control – HACCP.

UNIT- IV

Microbes as Food and Food Products:Fermented dairy products,Starterculture,Cheese: Types, curdling, processing, ripening,Other fermented dairy products (yogurt, acidophilus milk, kefir). Introduction to probiotics, prebiotics and synbiotics. Indian fermented food products: Pickles, idli, Khaman and bread.

UNIT- V

Microbes as food: Mushrooms, spirulina and yeasts in food microbiology.
Biological methods: Generalized scheme for microbiological examination, Direct microscopic examination,Most probable number (MPN), Bacteriological analysis of milk.
Microbiological criteria of food safety.

Text Books:

1. PelczarJr, M J, Chan E C S, Krieg N R, (1986), *Microbiology: AnApplication Based Approach*, 5th edn. McGraw-Hill Book Company, NY
2. Frazier W C and Westhoff D C (1988), *Food Microbiology*, 4th edn.McGraw-Hill Book Company, NY.
3. Prescott L, Harley J P, and Klein D A, (2008), *Microbiology*, 7th edn. WmC.Brown- McGraw Hill, Dubuque, IA.

Semester Fourth

Paper 4.3. BMB-15- Environmental Microbiology

Course Type : Core **Credits:4**

Duration :3 hrs

Continuous/Internal/Assessment : 30 Marks
Semester Assessment : 70 Marks

Note*: The syllabus is divided into five independent units and question paper will be divided into two sections.*

- ***Section-A*** *will carry 20 marks with one compulsory question comprising ten short answer type questions taking two questions from each unit. Each question shall be of two marks.*
- ***Section-B*** *will carry 50 marks with equally divided into five long answer type questions (answer about in 400 words). Paper setter shall be advised to set two questions from each unit and students are instructed to attempt five questions by selecting one question from each unit.*

UNIT-I

Introduction: Definition, history and development, aim and scope of aerobiology. Microbes and atmosphere: Atmospheric layers, sources of microorganisms, Air spora of indoor and outdoor environment, factors affecting air spora, significance of air-bornemicrobes, management of air-borne microbes. sampling of air.

UNIT-II

Aquatic environment, distribution of microorganisms in aquaticenvironment – fresh water, estuarine and marine water systems. Factors influencing growth anddistributions. Water Purification procedures for single dwelling and municipal water supplies,
Concept of indicator organisms, Microbiological examination of water. BOD, COD, Waste water

treatment steps and methods. Eutrophication and algal bloom.

UNIT -III

Pollution of air, water and land with reference to their causes, nature of pollutions, impact and control strategiesenvironmental damage by agriculture, perspectives of pollution in urban, industrial and rural areas. Habitat Pollution by Chlorinated Hydrocarbons (DDT, PCBs, Dioxin etc), Organophosphates, Heavy Metals, Die-offs, Endocrine disrupting chemicals.

UNIT-IV

Bioremediation. Biodegradation of paints, rubber, wood, products and plastics.Degradation of pesticides and other toxic chemicals by microbes.BiopesticidesEnrichment of ores by microorganisms (Bioaccumulation andBiomineralisation).

UNIT-V

Environmental Laws, national movements, sustainable development,environmental policies, environmental economics, environmental ethics – holistic approach of environmental protection and conservation, IUCN – role in environmental protection. Concept with reference to UN – declaration, aim and objectives of human right policies with reference to India, recent north-south debate on the priorities of implementation, Environmental Protection Agency (EPA).

References:

1. Environmental microbiology: Principles and applications by Patrick K. Jjemba.Science publisher, 2004.
2. Environmental microbiology by P. D. Sharma, Alpha Sciences international, 2005.
3. Environmental microbiology by Ian Papper and Charles Gerba, Elsevir Press.
4. Environmental microbiology by Rose Environmental microbiology Vol III-IV, 1999

Semester Fourth

Paper 4.4.BMB 16PRACTICALS IV

1. Digestion of DNA using restriction enzymes and analysis by agarose gel electrophoresis.
2. Ligation in DNA fragments.
3. Selection of recombinants by selectable markers.
5. Polymerase chain reaction (PCR).
6. Agarose Gel Electrophoresis
7. SDS-PAGE
8. Demonstration of RAPD.
9. Isolation of RNA.
10. Demonstration of Southern blotting.
11. Microbiological analysis of food
    A. Standard plate count of food sample
    B. Determination of MPN of coliforms

12. Microbiological analysis of milk
    A. Standard plate count of milk sample
    B. Determination of microbial load of milk by use of MBRT of raw milk, boiled milk and pasteurized milk
12. Detection of acid-fast organisms in milk sample.

13. To determine the microbial biomass from different natural habitats.

14.Determination of dissolved oxygen of water.

15.Determination of BOD of water (raw/ treated).

16.Determination of COD of water (raw/ treated).

17.Demonstration of biological treatment.