

**HINDUSTHAN COLLEGE OF ARTS AND SCIENCE (AUTONOMOUS)
COIMBATORE-641 028
B.Sc., MICROBIOLOGY
SCHEME OF EXAMINATIONS - CBCS PATTERN**

(For the students admitted from the Academic year 2018- 2019 and onwards)

CODE NO.	SUBJECT	LECTURE HRS /WEEK	EXAM DURATION HRS	MAXIMUM MARKS			CREDIT POINTS
				IE	EE	TOTAL	
First Semester							
Part- I							
16LAT01/ 16LAH01/ 16LAM01/ 16LAF01	Tamil-I/Hindi-I/Malayalam-I/French-I	6	3	25	75	100	3
Part-II							
16ENG01	English - I	6	3	25	75	100	3
Part-III							
16MBU01	Basic Concepts of Microbiology	6	3	25	75	100	4
-	Practical I - Principles of Microbiology and Microbial Physiology	5	-	-	-	-	-
16MBU02	Allied – Biometry and Computers (MAT)	5	3	25	75	100	3
16MBU03	Allied Practical I - Biometry and Computers (MAT)	2	3	40	60	100	2
Second Semester							
Part- I							
16LAT02/ 16LAH02/ 16LAM02/ 16LAF02	Tamil-II/Hindi-II/Malayalam-II/ French-II	6	3	25	75	100	3
Part-II							
16ENG02	English – II	6	3	25	75	100	3
Part-III							
16MBU04	Microbial Physiology and Metabolism	5	3	25	75	100	4
18MBU05	Practical I - Principles of Microbiology and Microbial Physiology	5	3	40	60	100	3

16MBU06	Allied - Biomolecules (MIC)	4	3	25	75	100	3
16MBU07	Allied Practical II - Biomolecules (MIC)	2	3	40	60	100	2
Part-IV							
16GSU01	Value Education – Human Rights	2	-	100	-	100	2
Third Semester							
Part- I							
16LAT03/ 16LAH03/ 16LAM03/ 16LAF03	Tamil-III/Hindi-III/ Malayalam - III /French-III	6	3	25	75	100	3
Part-II							
16ENG03	English - III	6	3	25	75	100	3
Part- III							
16MBU08	Bioinstrumentation	4	3	25	75	100	4
16MBU09	Microbial Genetics	4	3	25	75	100	4
-	Practical II - Bioinstrumentation, Microbial genetics, Bacteriology and Immunology	3	-	-	-	-	-
16MBU10	Allied - Biochemistry (MIC)	3	3	25	75	100	3
16MBU11	Allied Practical III - Biochemistry (MIC)	2	3	40	60	100	2
Part-IV							
16GSU02	Environmental Studies	2	-	100	-	100	2
Fourth Semester							
Part- I							
16LAT04 16LAH04/ 16LAM04/ 16LAF04	Tamil-IV/Hindi-IV/ Malayalam -IV/ French-IV	6	3	25	75	100	3
Part-II							
16ENG04	English - IV	6	3	25	75	100	3
Part- III							
16MBU12	Immunology	4	3	25	75	100	4
16MBU13	Medical Bacteriology	4	3	25	75	100	4
16MBU14	Practical II - Bioinstrumentation, Microbial genetics, Bacteriology and Immunology	3	9	40	60	100	3
16MBU15	Allied - Biostatistics (MAT)	3	3	25	75	100	3
16MBU16	Allied Practical IV - Biostatistics (MAT)	2	3	40	60	100	2
Part-IV							
16GSU03	Skill based Internet Security	2	3	100	-	100	2

Part-V							
16GSU04	Extension activity	-	-	100	-	100	2
Fifth Semester							
Part - III							
16MBU17	Industrial Microbiology	5	3	25	75	100	5
16MBU18	Food and Dairy Microbiology	5	3	25	75	100	5
16MBU19	Virology	5	3	25	75	100	5
16MBU20	Elective I a) Bioinformatics and Nanotechnology (OR) b) Pharmaceutical Microbiology	5	3	25	75	100	5
16MBU21	Skill based Textile Microbiology	4	3	25	75	100	4
-	Practical III – Virology, r DNA, Industrial, Food and Environmental Microbiology	6	-	-	-	-	-
Part-IV							
16GSU05	Non – Major Elective General Awareness	-	-	100	-	100	2
Part – V							
16GSU06	Law of Ethics	-	-	100	-	100	2
Sixth Semester							
Part – III							
16MBU22	Microbial Ecology	5	3	25	75	100	5
16MBU23	Genetic Engineering	5	3	25	75	100	5
16MBU24	Medical Mycology and Parasitology	5	3	25	75	100	5
16MBU25	Elective –II a) Entrepreneurship in Microbiology (OR) b) Large Scale Manufacturing Practices (OR) c) Bioethics, IPR and Biosafety	5	3	25	75	100	5
18MBU25							
18MBU26	Skill based Practical IV Lab in Bioinformatics	3	3	25	75	100	4
18MBU27	Practical III – Virology, r DNA, Industrial, Food and Environmental Microbiology	5	9	40	60	100	4
16MBU28	Mini Project	2	-	100	-	100	2
							140

REGULATIONS

Components for Evaluation:

1. Internal Examination Marks (For Part III theory papers)

Components	Marks
Test -I & II (Best of Two)	10
Model Exam	10
Assignment	5
Total	25

QUESTION PAPER PATTERN FOR I.E TEST I and II
(2 HOURS TEST)

SECTION - A (20 Marks)

Answer ALL Questions

ALL Questions Carry EQUAL Marks

Short answers 10

MAXIMUM: 50 Marks

(10 x 2 = 20 marks)

SECTION - B (10 Marks)

Answer ALL Questions

ALL Questions Carry EQUAL Marks

Either or Type

(2 x 5 = 10 marks)

SECTION - C (20 Marks)

Answer any TWO Questions out of THREE questions

ALL Questions Carry EQUAL Marks

(2 x 10 = 20 marks)

QUESTION PAPER PATTERN FOR IE Model Examination
(3 HOURS TEST)

SECTION - A (20 Marks)

Answer ALL Questions

ALL Questions Carry EQUAL Marks

TWO questions from each unit

(10 x 2 = 20 marks)

SECTION - B (25 Marks)

Answer ALL Questions

ALL Questions Carry EQUAL Marks

Either or Type.

(5 x 5 = 25 marks)

ONE question from each unit with internal choice

SECTION - C (30 Marks)

Answer any THREE Questions out of FIVE questions

ALL Questions Carry EQUAL Marks

ONE question from each unit

(3 x 10 = 30 marks)

2 a) Components for Practical I.E.

Components	Marks
Test –I	20
Test - II	20
Total	<u><u>40</u></u>

2 b) Components for Practical E.E.

Components	Marks
Completion of Experiments	50
Record	5
Viva	5
Total	<u><u>60</u></u>

3. Institutional/ Industrial Training, Mini Project and Major Project Work

<u>Institutional /Industrial Training</u>		<u>Mini Project</u>	<u>MajorProject Work</u>	
Components	Marks	Marks	Components	Marks
I.E Work Diary	25	-	I. E a) Attendance 10 Marks b) Review / Work Diary* ¹ 30 Marks	40
Report	50	50		
Viva –voce Examination	25	50		
Total	<u><u>100</u></u>	<u><u>100</u></u>	E.E * ² a) Final Report 40 Marks b) Viva-voce 20 Marks	60
			Total	<u><u>100</u></u>

*¹ Review is for Individual Project and Work Diary is for Group Projects (Group consisting of minimum 3 and maximum 5)

*²Evaluation of report and conduct of viva voce will be done jointly by Internal and External Examiners

4. Components for Value Education (Part IV):

S.No.	Components	Marks
a)	Attendance 96% and above - 30 marks 91% to 95% - 25 marks 86% to 90% - 20 marks 76% to 85% - 10 marks	30 marks
b)	Participation in group activity	30 marks
c)	Assignment (2 x 10)	20 marks
d)	Test (1 hr for 20 marks) 2 out of three questions, 10 marks each	20 marks
Total		100 marks

On completion of the above components students will be remarked as follows:

Range of marks	Equivalent remarks
80 and above	Exemplary
70 – 79	Very good
60 – 69	Good
50 – 59	Fair
40 – 49	Satisfactory
Below 39	Not Satisfactory = Not completed

- The passing minimum for this paper is 40%
- In case, the candidate fails to secure 40% passing minimum, he / she may have to reappear for the same in the subsequent semesters.

5. Guidelines for Environmental Studies (Part IV)

- The paper Environmental Studies is to be treated as 100% IE course which is offered in III Semester for II year UG students.
- The classes will be handled for two hours per week till the end of the Semester. At least one field trip should be arranged.
- Total Marks for the subject = 100

Components	Marks
Two Tests (2 x 30)	60
Field visit and report (10 + 10)	20
Two assignments (2 x 10)	20
Total	100

The question paper pattern is as follows:

Test I – 2 hours [3 out of 5 essay type questions] 3 x 10 = 30 Marks
Test II – 2 hours [3 out of 5 essay type questions] 3 x 10 = 30 Marks

Total 60 Marks

- The passing minimum for this paper is 40%
- In case, the candidate fails to secure 40% passing minimum, he / she may have to reappear for the same in the subsequent semesters.

6. Guidelines for Skill based subject - Internet Security (Part IV)

Components	Marks
Two Tests (2 x 40)	80
Two assignments (2 x 10)	20
Total	100

The question paper pattern is as follows:

a) Test I – 2 hours [4 out of 7 essay type questions] 4 x 10 = 40Marks
b) Test II – 2 hours [4 out of 7 essay type questions] 4 x 10 = 40 Marks

Total 80 Marks

- The passing minimum for this paper is 40%
- In case, the candidate fails to secure 40% passing minimum, he / she may have to reappear for the same in the subsequent semesters

7. Guidelines for General Awareness (Part IV)

Components	Marks
Two Tests (2 x 50)	100

The question paper pattern is as follows:

Test I – 2 hours [50 multiple choice questions] 50 x 1 = 50Marks
Test II – 2 hours [50 multiple choice questions] 50 x 1 = 50 Marks

Total 100 Marks

- The passing minimum for this paper is 40%
- In case, the candidate fails to secure 40% passing minimum, he / she may have to reappear for the same in the subsequent semesters

8. Guidelines for Law of Ethics (Part V)

Components	Marks
Two Tests (2 x 50)	100

The question paper pattern is as follows:

- c) Test I – 2 hours [5 out of 8 essay type questions] 5 x 10 = 50 Marks
d) Test II – 2 hours [5 out of 8 essay type questions] 5 x 10 = 50 Marks

Total 100 Marks

- The passing minimum for this paper is 40%
- In case, the candidate fails to secure 40% passing minimum, he / she may have to reappear for the same in the subsequent semesters

9. Guidelines for Extension Activity (Part V)

- Atleast two activities should be conducted within this semester (IV) consisting of two days each.
- The activities may be Educating Rural Children, Unemployed Graduates, Self Help Group etc.

The marks may be awarded as follows

No of Activities	Marks
2 x 50 (Each Activity for two days)	100

10. QUESTION PAPER PATTERN FOR EE (Part III Theory Papers)

(3 HOURS TEST)

MAXIMUM: 75 Marks

SECTION - A (20 Marks)

Answer ALL Questions

ALL Questions Carry EQUAL Marks

(10 x 2 = 20 marks)

TWO questions from each unit

SECTION - B (25 Marks)

Answer ALL Questions

ALL Questions Carry EQUAL Marks

(5 x 5 = 25 marks)

Either or Type.

ONE question from each unit with internal choice

SECTION - C (30 Marks)

Answer any THREE Questions out of FIVE questions

ALL Questions Carry EQUAL Marks

(3 x 10 = 30 marks)

ONE question from each unit

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Code No	Subject	Semester No
16MBU01	BASIC CONCEPTS OF MICROBIOLOGY	I
Objective:	To impart knowledge on the basics and fundamentals of Microbial world	
Course Outcome	On learning this core Paper, students will acquire knowledge and understand <ul style="list-style-type: none"> • The contribution of different scientists in the field of Microbiology • The fundamental concepts of Microbiology, such as the classification and identification of microbes. • Interpret the microscopic observation of microorganisms and maintenance of microbial cultures. • Core principles of sterilization and the different methods of sterilization • Pure culture techniques and preservation of cultures 	
Unit No	Topics	Hours
Unit I	History and scope of Microbiology Spontaneous generation theory and conflict - Contributions of Antony Von Leeuwenhoek - Joseph Lister - Louis Pasteur - Robert Koch - Edward Jenner - Alexander Fleming- John Tyndall - Scope of Microbiology.	14
Unit II	Microbial Taxonomy Domains and Kingdoms of life – Nomenclature - General characteristics of Eubacteria and Archaeobacteria - General characteristics, life cycle and economic importance of Algae (<i>Chlamydomonas</i>), Fungi (<i>Mucor</i>) and Protozoa (<i>Amoeba</i>)	14
Unit III	Microscopy, Stains and Staining Techniques Working principle and applications of light microscopes- Bright field, Dark field, Phase contrast, Fluorescence, Electron microscope- SEM and TEM. Definition of auxochrome, chromophores, dyes, Staining methods- Simple and Differential (Gram and Acid fast), Negative, Capsule, Flagellar and Endospore staining.	15
Unit IV	Sterilization and Disinfection Principles, methods of sterilization: Physical methods: Dry heat (Hot air oven), Moist heat (Autoclave) – Sterilization control. Filtration (Membrane & HEPA) and Radiation (UV). Chemical sterilization: Chemical agents and mode of action: Phenol coefficient test- sterilizing gas- Ethylene oxide.	15
Unit V	Culture techniques, Maintenance and Preservation of cultures Media preparations: Solid and liquid. Types of media: enriched, enrichment, selective, differential. Anaerobic culture technique: Wright's tube, Roll tube, McIntosh fields jar method. Pure culture technique: Serial dilution, pour, spread, streak plate methods. Culture preservation- Mineral oil method and Lyophilization.	14

Text Book: Prescott, Hareley.P and Klein.A., "Microbiology", McGraw Hill Publishers, New Delhi.

Reference Books

1. Michael J Pelczar.Jr., "Microbiology", McGraw Hill Publishers, New Delhi.
2. R.C Dubey., "Textbook of Microbiology", S. Chand and Company Ltd, New Delhi.
3. Gerard J. Tortora and Berdell R. Funke Christine L. Case., "Microbiology, An Introduction", Calif Benjamin/Cummings Pub. Co., SanFrancisco.
4. Jacquelyn G. Black, Laura J. Black., "Microbiology: Principles and Explorations", Wileys Publishers, New Jersey.

Code No	Subject	Semester No
16MBU04	MICROBIAL PHYSIOLOGY AND METABOLISM	II
Objective:	To impart knowledge on various aspects of microbial physiology and metabolism	
Course Outcome	On completion of the course, students will be able to: Understand concepts of nutritional requirements growth and reproduction of bacteria Know anatomy of prokaryotic cell and eukaryotic cell Explore the metabolic pathways involved in aerobic respiration and photosynthesis Discover anaerobic respiration and fermentation • Describe the microbial biosynthetic pathways	
Unit No	Topics	Hours
Unit I	Bacterial Cell structure and Function Subcellular structures of microbes- slime layer - capsule, cell wall- Gram positive and Gram negative, cytoplasmic membrane - pili- flagella - storage granules- comparison of prokaryotic and eukaryotic organisms- sporulation and germination- cell division in bacteria- binary fission.	12
Unit II	Nutrition Nutritional requirements of microorganisms –macro elements, micro elements and growth factors, nutritional groups of microbes - transport mechanisms and types-simple diffusion – facilitated diffusion- active transport – group translocation - Ion transport. Growth curve – Generation time – factors influencing microbial growth – batch, continuous , synchronous growth - diauxic growth.	12
Unit III	Aerobic respiration and Photosynthesis EMP – HMP – ED pathways – TCA cycle- electron transport chain (ETC) – oxidative and Substrate level phosphorylation - photosynthesis – oxygenic and anoxygenic, carbon dioxide fixation.	12
Unit IV	Anaerobic respiration and Fermentation Anaerobic respiration – sulphur, nitrogenous compounds and CO ₂ as final electron acceptor - Fermentation – alcoholic, lactic acid, propionic, butanediol and mixed acid fermentation.	12
Unit V	Biosynthesis Biosynthesis of bacterial cell wall - Biosynthesis of aminoacids (Pyruvate family)- Biosynthesis of fatty acids - general pathway- Biosynthesis of purine and pyrimidine nucleotides denovo and salvage pathways- bioluminescence	12

Text Book: Caldwell DR., "Microbial physiology and Metabolism", WMC Brown Publishers, New Delhi.

Reference Books

1. Moat, A.G. and Foster, J.W., "Microbial Physiology", Springer, New York.
2. Schlegel HG., "Microbiology" Cambridge University press, London.
3. Stainer, R.Y., Ingraham, J.L., Wheelis, M.L. and Painter, P.R., "Microbial Physiology", McGraw-Hill Higher Education New York.
4. Lehninger, Nelson and Cox., "Principles of Biochemistry", W.H. Freeman & Company, New York.

Code No	Subject	Semester No
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18MBU05	PRACTICAL I PRINCIPLES OF MICROBIOLOGY AND MICROBIAL PHYSIOLOGY	I & II
Objective:	To impart practical knowledge on Microbiology and Microbial Physiology	
Course Outcome	On completion of the course, students are able to: <ul style="list-style-type: none"> • Develop basic skill in aseptic techniques • Understand various accessories for Microbiology practicals • Perform various staining techniques • Cultivate bacteria and Perform various biochemical tests • Analyze microbial growth by different methods 	
LIST OF EXPERIMENTS <ol style="list-style-type: none"> 1. Laboratory Safety 2. Cleaning of Glassware 3. Operation and maintenance of Microscope 4. Culture media preparation colonies characteristics in Broth and agar medium 5. Selective and differential media <ol style="list-style-type: none"> a) EMB agar b) Mannitol salt agar c) Mac conkey agar 6. Pure culture techniques – Serial dilution, Pour plate, Spread plate and Streak Plate methods 7. Enumeration of bacteria, fungi and actinomycetes from soil 8. Determination of Motility – Hanging drop method and agar deep 9. Staining of Bacteria and fungi <ol style="list-style-type: none"> a. Simple staining b. Gram staining c. Negative staining d. Acid fast staining (demo) e. Endospore staining f. Fungal staining –LPCB / KOH 10. Micrometry- determination of size of bacteria. 11. Observation of representative forms of (Algae)– Anabena - Volvox; Fungi – Yeast, Penicillium, Parasites- Entamoeba, Plasmodium. 12. Biochemical characterization <ol style="list-style-type: none"> a) IMViC tests b) Catalase and Oxidase tests, urease and nitrate tests c) Triple sugar iron agar test 13. Carbohydrate fermentation tests 14. Hydrolysis test <ol style="list-style-type: none"> a. Starch hydrolysis b. Gelatin c. Casein hydrolysis tests 15. Cultivation of anaerobes- Wrights tube method, Mc Intosh fildes jar 16. Determination of Bacterial growth - Direct count Neubauer counting chamber, Turbidity. 17. Algal wet mount-filamentous and colonial forms. 18. Examination of Hay infusion broth under light microscope for protozoa. 		

Code No	Subject	Semester No
16MBU06	ALLIED - BIOMOLECULES (MIC)	II
Objective:	To emphasis the knowledge on Biomolecules	
Course Outcome	On completion of the course, students learn about: <ul style="list-style-type: none"> • The importance of carbohydrates • The characteristics of aminoacids • The properties of lipids • The structure and types of nucleic acids • The characteristics and action of enzymes 	
Unit No	Topics	Hours
Unit I	Carbohydrates Monosaccharides, disaccharides and polysaccharides - classification, structure, biological and physiological importance.	09
Unit II	Amino acids Classification of aminoacids – essential amino acids – properties – zwitter ion – isoelectric. Proteins: classification and function of proteins- structural level of organization.	10
Unit III	Lipids Classification and properties of lipids. Types of fatty acids – saturated, unsaturated and essential fatty acids. Classification and significance of lipoproteins, glycolipids and phospholipids. Biological significance of steroids and cholesterol.	10
Unit IV	Nucleic acids Components of DNA and RNA. Double helical structure of DNA - Structure and types of RNA.	09
Unit V	Enzymes Classification of enzymes with examples, coenzymes and cofactors (structures not needed) – Active site: Lock and key model- induced fit hypothesis. Factors affecting enzyme activity. Enzyme inhibitors. Chemical and industrial applications of enzymes.	10

Text Book: Deb A.C., "Fundamentals of biochemistry", New Central Book Agency, Calcutta.

Reference Books

1. Ambika Shanmugam., "Fundamentals of Biochemistry for Medical students" WMC Brown Publishers, New Delhi.
2. Sathyanarayana U., "Biochemistry", Books and Allied Pvt. Ltd., New Delhi.
3. Lehninger A.L., and Nelson D.L., " Principles of Biochemistry", Cox- CBS Publishers, New Delhi.
4. Lubert Stryer., "Biochemistry", Freeman and Company, New York.

Code No	Subject	Semester No
16MBU07	ALLIED PRACTICAL-II – BIOMOLECULES (MIC)	II
Objective:	To impart practical knowledge on biomolecules	
Course Outcome	On completion of the course students learn about <ul style="list-style-type: none">• Analyzing Sugars• Analyzing aminoacids• Characterizing lipids	
LIST OF EXPERIMENTS		
QUALITATIVE ANALYSIS		
1. Analysis of carbohydrates		
a. Monosaccharides- Hexoses- Glucose and Fructose		
b. Disaccharides- Sucrose and Lactose		
c. Polysaccharide- Starch		
2. Analysis of Amino acids		
a. Histidine b. Tyrosine. c. Tryptophan d. Arginine		
3. Characterization of Lipids		
a. Determination of acid number.		
b. Determination of iodine number.		



HEAD

Department of Microbiology
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Coimbatore- 641 028

Code No	Subject	Semester No
16MBU08	BIOINSTRUMENTATION	III
Objective:	To impart the knowledge on bioinstrumentation techniques	
Course Outcome	On completion of the course, students learn about: <ul style="list-style-type: none"> • Methods of handling basic laboratory equipments • Biosafety procedures in Microbiology • The principles of centrifugation with the types • Advance instrumentation such as Spectrophotometer, FTIR and flame photometry. • Separation of biomolecules and the techniques involved with instrumentation 	
Unit No	Topics	Hours
Unit I	Lab equipments Principles and applications of pH meter – inoculation loop - colony counter – anaerobic jar – water bath – micropipette- Principles and applications of lyophilizer.	09
Unit II	Laboratory Instrumentation Principles and applications of Incubator, auto clave, hot air oven, laminar air flow chamber - biosafety cabinets, shaker, incinerator, magnetic stirrer, rotary vacuum evaporator - ultra sonicator-transilluminator.	09
Unit III	Centrifugation Principle and Instrumentation of different types of rotors - types of centrifuges – low speed, high speed, ultra centrifuge - differential - density gradient centrifugation - applications.	10
Unit IV	Colorimetry & Spectrophotometry Principle and instrumentation of - colorimetry and spectrophotometry – single, double beam- UV & Visible Spectrophotometer – infra red spectroscopy- FTIR - flame photometry.	10
Unit V	Chromatography & Electrophoresis Principles and applications of - paper – thinlayer- column- ion-exchange - gas and HPLC. Electrophoresis – SDS – PAGE and agarose gel electrophoresis- Staining and visualization of bands.	10

Text Book: Upadhyay & Upadhyay., “Biophysical Chemistry”, Himalaya Publishing House, New Delhi.

Reference Books

1. Dean, Willard and Merrit., “Instrumental Methods of analysis”, Asian Ed, India.
2. Keith Wilson and John Walker., “Principles and Techniques of Biochemistry and Molecular biology”, Cambridge University Press, UK.
3. Boyer, Rodney, F. Benjamin and Cummins., “Modern Experimental Biochemistry”., Himalaya Publishing House, New Delhi.
4. Gedder, A. and L. E. Balser., “Principles of applied Biomedical instrumentation”, John Wiley and Sons, New York.

Code No	Subject	Semester No
16MBU09	MICROBIAL GENETICS	III
Objective:	To emphasize the knowledge on microbial genetic transformation	
Course Outcome	On completion of the course, students learn about: <ul style="list-style-type: none"> • Structure and Genome organization • DNA damage and repair • Enzymology and the methods of DNA replication • The mechanisms of transcription and translation • Gene regulations and operon models in bacteria. • The methods of gene transfer in bacteria 	
Unit No	Topics	Hours
Unit I	Genetic Materials Genetics- historical introduction- DNA as a genetic material – structure and chemical composition of DNA- Watson and Crick model – topological forms of DNA. Organization of genes in prokaryotes - RNA as a genetic material.	09
Unit II	Replication DNA replication – semi conservative- Meselson and Stahl’s experiment- replication in Prokaryotes – mechanism and enzymology of replication – helicase, DNA gyrase, polymerases, ligase - rolling circle model – theta replication.	09
Unit III	Transcription and Translation Enzymology and mechanism of transcription in prokaryotes - structure of mRNA, rRNA and tRNA - genetic code – characteristics of genetic code - Enzymology and mechanism of translation in prokaryotes.	10
Unit IV	Mutation and gene regulation Mutation – spontaneous and induced mutations- mutagenesis- - Physical and chemical agents – site specific mutagenesis- mutagenicity testing - DNA damage and repair - regulation of gene activity- operon model- <i>lac</i> and <i>trp</i> operon.	10
Unit V	Gene recombination in bacteria Transformation – transduction (Specialized & Generalized)-conjugation F^+ v/s F^- , Hfr^+ v/s F^- - recombination – homologous recombination - site specific recombination and transposition.	10

Text Book: David Freifelder., “Molecular biology”, Narosa publishing house, New Delhi.

Reference Books

1. Gardner, E. J, Simmons, M J & D P Snustard., 2008 “Principles of Genetics”, John Wiley & Sons, New York.
2. Robert H .Tamarin., “Principles of Genetics”, WmC Brown Publishers, New York.
3. Lewin.B., “Gene”, Oxford University Press, New York
4. Klug .W.S. & Cummings, MR., “Essentials of Genetics”, Mentics Hail, NewJersey.

Code No	Subject	Semester No
16MBU10	ALLIED – BIOCHEMISTRY (MIC)	III
Objective:	To impart knowledge on the basics of biochemistry.	
Course Outcome	On completion of the course, students learn about: <ul style="list-style-type: none"> • The importance of Buffer system • The characteristics and action of enzymes • The properties and physiological functions of vitamins • The hormones and their disorders & syndromes • The inborn errors of metabolism 	
Unit No	Topics	Hours
Unit I	Buffer system pH – acid base indicators - Henderson – Hasselbalch equation – buffer systems of blood and body fluids acidosis and alkalosis – distribution of fluids in the body – dehydration.	07
Unit II	Bioenergetics Basic principles of thermodynamics – entropy, enthalpy and free energy. High energy phosphates, oxidation – reduction reactions – oxidases, dehydrogenases, oxygenases – organization of the respiratory chain in mitochondria.	07
Unit III	Vitamins and Minerals Classification, properties and physiological functions of vitamins – fat soluble – (A,D,E and K) and water soluble (B and C) – deficiency – Macronutrients – Physiological importance of Calcium , Phosphorus, Magnesium, Sodium and Potassium – Trace elements – Physiological functions of Iron, Copper and Iodine	07
Unit IV	Hormones General characteristics – classification – functions of thyroid stimulating hormone (TSH) – oxytocin – vasopressin – thyroid – thyrosine – pancreas – insulin – diabetes.	07
Unit V	Inborn errors of Metabolism Hereditary anemias – sickle cell anemia and thalassemia – errors of carbohydrate (galactosemia) and protein metabolism (phenylketonuria) – disease and syndromes.	08

Text Book: Deb A.C., “Fundamentals of biochemistry”, New Central Book Agency, Calcutta.

Reference Books

1. Ambika Shanmugam., “Fundamentals of Biochemistry for Medical students” WMC Brown Publishers, New Delhi.
2. Sathyanarayana U., “Biochemistry”, Books and Allied Pvt. Ltd., New Delhi.
3. Lehninger A.L., and Nelson D.L.,” Principles of Biochemistry Cox- CBS Publishers, New delhi.
4. Lubert Stryer., “Biochemistry”, Freeman and Company, New York.

Code No	Subject	Semester No
16MBU11	ALLIED PRACTICAL-III – BIOCHEMISTRY (MIC)	III
Objective:	To impart practical knowledge on biochemistry	
Course Outcome	On completion of the course students learn to <ul style="list-style-type: none">• Measure pH in solutions• Prepare Molar and Normal solutions• Estimate Proteins, carbohydrates	
LIST OF EXPERIMENTS		
<ol style="list-style-type: none">1. Measurement of pH2. Preparation of Buffers – Acids and Alkaline Range3. Preparation of Solutions (Molar and Normal Solutions)4. Protein estimation (Lowry <i>et al</i>)5. Quantitative of determination protein by Bradford method6. Determination of Maximum absorption (μ_{max}) spectra of standard Proteins7. Quantitative determination of carbohydrate by Anthrone method8. Estimation of Carbohydrates(DNSA method)		



HEAD

Department of Microbiology
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Code No	Subject	Semester No
16MBU12	IMMUNOLOGY	IV
Objective:	To impart knowledge on Immune system, related disease and Immunodetection	
Course Outcome	On completion of the course, students learn: <ul style="list-style-type: none"> • To describe Immune system and immune response • The importance and types of antigen and antibodies and complement • To distinguish about Hypersensitivity and Autoimmune diseases • It improves the knowledge about grafting and immunohaematology • The skills required in the field of serological kit preparation in diagnostics 	
Unit No	Topics	Hours
Unit I	Immune system History and Scope of Immunology - Types of immunity – innate and acquired. Hematopoiesis Cell and Organs involved in immune system - Phagocytosis, apoptosis and necrosis.	09
Unit II	Antigen and Antibody Antigen: types, chemical and molecular nature: haptens, adjuvants. Immunoglobulins types - structure and functions. Complement pathways - Classical and Alternate	09
Unit III	Hypersensitivity and Auto immune diseases Allergy and Hypersensitivity - Classification types and Mechanisms – Immunodeficiency diseases- auto immune diseases and their treatments- systemic and organ specific auto immune diseases.	10
Unit IV	Grafting and Immunoematology Types of grafting, mechanism of graft rejection – MHC- HLA typing - tumors of the immune system - Monoclonal antibodies and its applications (Hybridoma technology) Immunoematology - Blood transfusion - ABO grouping - Rh factor - Tissue typing	10
Unit V	Immunotechnology Detecting antigen – antibody interaction – cross reactivity- affinity- avidity– precipitation-VDRL – agglutination Blood grouping, WIDAL, RIA – ELISA – western blotting – immuno precipitation – immunofluorescence, complement fixation test.	10

Text Books: Coleman, R.M., Lourbard, M.F and Sicard, R.E., "Fundamental immunology", W.H. Freeman and co., New York

Reference Books

- 1) Kuby, J., "Immunology", W.H. Freeman and co., New York.
- 2) Roitt, I.M., "Essential of Immunology", Black Well Scientific Publishers, New York.
- 3) Tizard, R.I., "Immunology-An Introduction", Saunder's College publishers, Philadelphia.
- 4) Ashim K. Chakravarthy., "Immunology", TataMcGraw-Hill, New Delhi.

Code No	Subject	Semester No
16MBU13	MEDICAL BACTERIOLOGY	IV
Objective:	To enable students to learn the pathophysiology of bacterial infections	
Course Outcome	On completion of the course, students can <ul style="list-style-type: none"> • Understand the types of infections, sources and methods of spread • Explain the pathogenicity of Gram positive organisms • Categorize the common gram negative bacterial infections • Describe the pathogenicity of mycobacteria, spirochaetes and rickettsiae • Isolate and identify microorganism from laboratory samples. • Perform antibiotics sensitivity testing and interpretation 	
Unit No	Topics	Hours
Unit I	Infections Normal microflora of human body - Sources and types of infections- methods of transmission – Virulence Factors - adhesion, exotoxins and endotoxins - Epidemic, Endemic and Pandemic diseases- Infectious disease cycle.	09
Unit II	Gram positive organisms Gram positive organisms - Morphology, cultural characteristics, pathogenicity <i>Staphylococcus aureus</i> , <i>Streptococcus pyogenes</i> , <i>Pneumococcus</i> , <i>Bacillus anthracis</i> , <i>Clostridium tetani</i> and <i>Clostridium botulinum</i> .	09
Unit III	Gram negative organisms Gram negative organisms Morphology, cultural characteristics, pathogenicity and clinical manifestations of <i>E. coli</i> , <i>Klebsiella pneumoniae</i> , <i>Salmonella typhi</i> , <i>Shigella dysenteriae</i> , <i>Pseudomonas aeruginosa</i> , <i>Vibrio cholerae</i> , <i>Neisseria gonorrhoeae</i> , and <i>Neisseria meningitidis</i> .	10
Unit IV	Mycobacteria, Spirochaetes and Intracellular parasites Morphology, cultural characteristics, pathogenicity and clinical manifestations of <i>Corynebacterium diphtheriae</i> , <i>Mycobacterium tuberculosis</i> , <i>Mycobacterium leprae</i> . <i>Spirochaetes – Treponema pallidum</i> , and <i>Leptospira icterohaemorrhagiae</i> , <i>Mycoplasma pneumoniae</i> , <i>Rickettsia rickettsii</i> and <i>Chlamydia trachomatis</i> .	10
Unit V	Diagnosis Laboratory diagnosis of common bacterial infections– Process of sample collection, transportation and processing- antibiotics- modes of action- Antibacterial susceptibility testing- drug resistance.	10

Text Books : Ananthanarayan and Jayaram Paniker., "Textbook of Microbiology", University Press India Pvt Ltd. New Delhi.

Reference Books

1. Jawetz E Melnic JL and Adelberg EA , "Review of Medical Microbiology"., Lange Medical Publications, USA.
2. Mackie and Mc catney, " Medical Microbiology No I and II"., Churchill Livingstone, USA.
3. Bailey and Scotts "Diagnostic Microbiology", 9th edition, Baron and Finegold CV Mosby Publications, USA.
4. David Greenwood "Medical Microbiology", Churchill Livingstone, USA.

Code No	Subject	Semester No
16MBU14	PRACTICAL II BIOINSTRUMENTATION, MICROBIAL GENETICS, BACTERIOLOGY AND IMMUNOLOGY	III & IV
Objective:	To impart practical knowledge on bioinstrumentation, Microbial genetics, bacteriology and Immunology	
Course Outcome	On completion of the course, students are able to: <ul style="list-style-type: none"> • Perform and report immunological tests • Comprehend the different methods of mutagenesis • Illustrate pathogens from microscopic observation • Identify clinically important bacteria • Perform Immunological tests • Develop strategy and significance on genetic analysis of microbial forensic evidences. • Interpret the efficacy of disinfectant 	
LIST OF EXPERIMENTS		
<ol style="list-style-type: none"> 1. Separation of amino acids by paper chromatography 2. Separation of sugars by thin layer chromatography 3. Separation of proteins by SDS- PAGE 4. Isolation of chromosomal DNA from bacteria 5. Isolation of plasmid DNA from <i>E.coli</i> 6. Isolation of mutants using physical agent -UV 7. Isolation of auxotrophic mutants using chemical agents 8. Isolation of antibiotic resistant mutants by Gradient plate 9. Identification of clinically important bacteria–<i>Staphylococcus aureus</i> 10. Identification of <i>Streptococcus pyogenes</i>, 11. Identification of <i>E.coli</i> 12. Identification of <i>Salmonella</i> 13. Identification of <i>Klebsiella</i> 14. Identification of <i>Pseudomonas</i> 15. Identification of <i>Proteus</i> 16. Microscopic identification of clinically important fungi <ol style="list-style-type: none"> a. <i>Candida albicans</i>, b. <i>Cryptococcus neoformans</i> c. Aspergillus. 17. Direct examination of parasites in blood- Thick and thin film 18. Antibiotic sensitivity testing – Kirby Bauer method 19. Agglutination - Blood grouping, WIDAL 20. Precipitation -VDRL 21. Immunodiffusion- Ouchterlony's double Immunodiffusion 22. ELISA 23. Testing of efficacy of disinfectants- Phenol coefficient test 		


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Code No	Subject	Semester No
16MBU17	INDUSTRIAL MICROBIOLOGY	V
Objective:	To emphasize the knowledge on production, strain development, microbial product production and recovery	
Course Outcome	On completion of the course, students learn about: <ul style="list-style-type: none"> • Industrial microorganisms and Strain improvement • The design of different types of fermenter • Categorizing different media and nutrients for industrial fermentation • Product recovery and purification • Scale up and large scale production of alcohol, enzymes, antibiotics etc., 	
Unit No	Topics	Hours
Unit I	Introduction to Fermentation Fermentation definition and types- submerged and solid state. Industrially important strains- Screening methods- Strain development for Improved yield- Mutation, Recombination and protoplasmic fusion. Strain preservation.	12
Unit II	Fermentor types and design Fermentor design and its types (Tower, cylindroconical & airlift) – Batch fermentation – Continuous fermentation and fed batch fermentation. Computer application in fermentation technology. Strain preservation.	12
Unit III	Upstream Process Substrate for industrial fermentation solid and liquid media formulation strategies- economical means of providing energy. Carbon, nitrogen, vitamin, mineral sources, buffers, precursors, inhibitors, inducers and antifoam. Sterilization of media	12
Unit IV	Downstream process Product recovery and purification - intracellular and extracellular products- cell disruption, centrifugation, filtration, flotation chromatography, flocculation, solvent extraction, precipitation, drying crystallization - packaging and marketing	12
Unit V	Application Of Bioprocess Technology Commercial production of beer, wine, antibiotics- Penicillin, Enzymes- Amylase. Amino acids - Glutamic acid. Immobilization of enzymes, Production of bakers yeast, Spirullina , ethanol production. Biochips, biofilters and flavouring agents.	12

Text Books: A.H. Patel., "Industrial Microbiology", Macmillan India Publishers, New Delhi.

Reference Books

1. Stanbury P T and Whitaker., " Principles of Fermentation Technology", Pergamon Press, New York.
2. Casida, L E JR., "Industrial Microbiology", New Age International Publishers, New Delhi.
3. Prescott and Rehm., " Industrial Microbiology", Wiley and Sons, France.
4. Nduka Okafor., "Modern Industrial Microbiology and Biotechnology", CRC Press, New Delhi.

Code No	Subject	Semester No
16MBU18	FOOD AND DAIRY MICROBIOLOGY	V
Objective:	To emphasize the food and dairy microflora, preservation and spoilage	
Course Outcome	On completion of the course, students learn about: <ul style="list-style-type: none"> • Food and dairy micro flora, preservation • Discriminating spoilage causing organisms in food • Tests used in Industries and fermented food products • Understand food laws and regulations as per the WHO standards, HACCP & disposal of the waste products. • Fermented food products 	
Unit No	Topics	Hours
Unit I	Food microflora and preservation of foods Introduction- Importance of food microbiology – types of microorganisms in food – factors influencing microbial growth of food (extrinsic and intrinsic) – Principles of food preservation – Asepsis – physical and chemical methods.	12
Unit II	Food spoilage Contamination and spoilage – cereals, sugar products, vegetables and fruits, meat and meat products, milk and milk products, fish and seafood – poultry, spoilage of canned foods. Food poisoning and food borne infections – bacterial and mycotoxins.	12
Unit III	Dairy Microbiology Milk - definition, composition and types of milk (skimmed, toned and homogenized. microbial analysis of milk - microflora of raw milk - dye reduction test (using methylene blue and resazurin) - Total bacterial count- Brucella ring test and tests for mastitis - Somatic cell count, pasteurization of milk, milk borne diseases.	12
Unit IV	Fermented Foods Fermented food – pickled cucumber, saurkraut- soysauce, bread, idli – Fermented dairy products – Yoghurt and cheese.	12
Unit V	Food Quality assurance and dairy hygiene Food laws and regulation - HACCP - Codex alimentarius. Industry hygiene cleaning of dairy equipment - In-plant cleaning system. Dairy processing plant sanitation - utilization and disposal of dairy by product – whey.	12

Text Books: Adams M.R. and M.O. Moss., "Food Microbiology", The royal Society of Chemistry, Cambridge, New York.

Reference Books

1. Fraizer W.C. and Westhoff D.C., "Food Microbiology", TATA McGraw Hill Publishing Company Ltd. New Delhi.
2. Robinson R., "Dairy Microbiology, Elsevier Applied Science Pub, New York.
3. James M. Jay, Martin J. Loessner, David A. Golden., "Modern Food Microbiology," Springer New York.
4. Yadav J.S. Sunitha G. and V.K. Batish., "Comprehensive dairy Microbiology", Metropolitan Book Co., New Delhi.

Code No	Subject	Semester No
16MBU19	VIROLOGY	V
Objective:	To describe the replications and life cycle strategies of DNA and RNA Viruses	
Course Outcome	On completion of the course, students <ul style="list-style-type: none"> • Learn the structure and cultivation of Viruses • Will be able to categorize the life cycle of DNA phages • Acquire knowledge on the Life cycle of bacteriophages • Understand the structure and replication of plant viruses. • Obtain knowledge on the structure , properties and diagnosis of animal viruses. 	
Unit No	Topics	Hours
Unit I	General structure and cultivation of viruses Early development of virology- General, structural properties of virus – helical, icosahedral and complex symmetry. Baltimore system of classification- cultivation of viruses experiment animals, embryonated eggs and cell cultures - Assay of viruses.	12
Unit II	Reproduction of DNA phages Reproduction of DNA phages – dsDNA T ₄ lytic cycle – lytic cycle adsorption - penetration- synthesis -assembly - release of phage particles - one step growth experiment. ssDNA phage - ØX 174 replication	12
Unit III	Life cycle of phage Temperate bacteriophages – prophage – integration and excision. defective phages – λ phage - conversion between lytic & lysogeny - reproduction of RNA phages.	12
Unit IV	Plant Viruses General properties, structure, genome replication of DNA containing virus – CaMV and gemini virus- RNA containing viruses – TMV and BMV- Myco and Phycophages	12
Unit V	Animal Viruses General properties, structure, genome replication, laboratory diagnosis, prophylaxis and treatment of DNA containing virus–Adeno, Herpes Simplex (1 & 2) - RNA containing viruses - AIDS, hepatitis (A,B& C), ebola, dengue, influenza HINI, polio virus- oncogenic viruses, antiviral agents.	12

Text Book: Prescott L.M, Harley, J.P Klein D.A., 2001 "Microbiology", Wm C Publishers, New Delhi.

Reference Books

1. Luria S.E. Darnel, J.E Jr. Baltimore. D and Campbell A., " General Virology", Wiley and sons, France.
2. John Carter., "Virology: Principles and Applications" Wiley Publications, France.
3. Nicholas H. Acheson., "Fundamentals of Molecular Virology", Wiley Publications, France.
4. Shubhrata.R.Mishra., "Virus and plant diseases", Discovery publishing house, New Delhi.

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Code No	Subject	Semester No
16MBU20	BIOINFORMATICS AND NANOTECHNOLOGY	V
Objective:	To develop basic idea about application of computers and nanomaterials in biology	
Course Outcome	On completion of the course, students learn about: <ul style="list-style-type: none"> • The basic concepts in Bioinformatics • To analyze databases and to construct phylogenetic trees • To outline alignment methods. • Acquire knowledge on the Synthesis of Nanoparticles • To comprehend the applications of nanoparticles in different fields 	
Unit No	Topics	Hours
Unit I	Introduction to Bioinformatics Scope of Bioinformatics – Elementary commands and Protocols, ftp, telnet, http. Printer on information theory. Databanks – nucleotide databanks – Genbank, NCBI, EMBL, DDBJ – protein databanks – sequence databanks – PIR, SWISSPROT, TrEMBL - structural databases – PDB, SCOP, CATH.	12
Unit II	Databases Introduction to databases – database search – Algorithms issues in database search – sequence database search – FASTA – BLAST – Amino acid substitution matrices PAM and BLOSUM. GCG Sequence Analysis(Basic concepts only) Ultrasonic trees – parsimony – Ultrametric problem – Perfect phylogeny – Phylogenetic alignment – connection between multiple alignment and tree construction	12
Unit III	Alignment Methods Introduction – Strings – Edit distance two strings – string similarity local alignment -gaps – parametric sequence alignments – suboptimal alignments – multiple alignment – common multiple alignment methods.	12
Unit IV	Nanostructure Classification: Classification of Nanostructures-1D,2D and 3D nanomaterials- Nanoscale Architecture. Synthesis of Nanomaterials: Top down –ballmilling: Bottom up-co-precipitation-sol-gel-electrodeposition -using natural nanoparticles –chemical vapor deposition.	12
Unit V	Application of Nanomaterials Nanomedicines, immune toxins, liposomes as drug carriers , gene therapy, personalized medicine, DNA computers, artificial life, biosensors.	12

Text Book: S. Ignacimuthu., “Basic Bioinformatics”, Alpha Science International, Tamil Nadu

Reference Books

1. K.K.Jain., “Nano Biotechnology”, Horizons Biosciences, Tamil Nadu.
2. Dan Gusfield., “Algorithms on Strings Trees and Sequences”, Cambridge University Press, London.
3. Lesk., “Introduction to Bioinformatics”, Cambridge University Press, London.
4. Baxevanis, “Bioinformatics”, John Wiley & Sons, New York.

Code No	Subject	Semester No
16MBU20	PHARMACEUTICAL MICROBIOLOGY	V
Objective:	To emphasize the knowledge on microbial production of pharmaceutical products	
Course Outcome	On completion of the course, students learn about: <ul style="list-style-type: none"> • Antibiotics and synthetic antimicrobial agents • The mechanisms of action of antibiotics and the principles of drug targeting • Production of few biopharmaceuticals • Regulatory aspects in pharmaceutical industry • The skills in designing a drug for the diseases caused by viruses, fungi, bacteria etc. 	
Unit No	Topics	Hours
Unit I	Antibiotics and synthetic antimicrobial agents Antibiotics and synthetic antimicrobial agents (Aminoglycosides, β lactams, tetracyclines, ansamycins, macrolid antibiotics) - Antifungal antibiotics, antitumor substances. Peptide antibiotics, chloramphenicol, sulphonamides and quinolone antimicrobial agents - Chemical disinfectants, antiseptics and preservatives.	12
Unit II	Mechanism of action of antibiotics Mechanism of action of antibiotics (inhibitors of cell wall synthesis, nucleic acid and protein synthesis) - Molecular principles of drug targeting - Drug delivery system in gene therapy Bacterial resistance to antibiotics - Mode of action of bacterial killing by quinolones. Bacterial resistance to quinolones - Mode of action of non - antibiotic antimicrobial agents.	12
Unit III	Microbial production and Spoilage of pharmaceutical Products Microbial contamination and spoilage of pharmaceutical products (sterile injectibles, non injectibles, ophthalmic preparations and implants) and their sterilization - Manufacturing procedures and in process control of pharmaceuticals - Other pharmaceuticals produced by microbial fermentations (streptokinase, streptodornase).	12
Unit IV	Regulatory practices, biosensors and applications in Pharmaceuticals Government regulatory practices and policies - FDA perspective. Reimbursement of drugs and biologicals, legislative perspective. Rational drug design - Immobilization procedures for pharmaceutical applications (liposomes). Macromolecular, cellular and synthetic drug carriers - Biosensors in pharmaceuticals - Application of microbial enzymes in pharmaceuticals.	12
Unit V	Quality Assurance and Validation Good Manufacturing Practices (GMP) and Good Laboratory Practices (GLP) in pharmaceutical industry - Regulatory aspects of quality control - Quality assurance and quality management in pharmaceuticals ISO, WHO and US certification.	12

Text Book: D. Golan, A. Tashjian, E. Armstrong, J.Galanter, A.W.Armstrong, R. Arnaout and H.Rose., "Principles of Pharmacology", Lippincott Williams and Wilkins, New York.

Reference Books

1. J.Hardman, Lee Limbird and A.G. Gilman., "Goodman and Gilman's The Pharmacological Basis of Therapeutics". Lippincott Williams and Wilkins, New York.
2. Huge, W.B. and Russel, "Pharmaceutical Microbiology", AD.Blackwell Scientific, Oxford
3. Lancini, G. and Parenti, F. "Antibiotics", Springer-Verlag.
4. Block, S.S. "Disinfection, sterilization and preservation", Lea and Febigor, Baltimore.

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Code No	Subject	Semester No
16MBU21	TEXTILE MICROBIOLOGY	V
Objective:	To emphasis the knowledge of textile antimicrobial preparation and validation	
	On completion of the course, students learn about: <ul style="list-style-type: none"> • Antimicrobial agents and the pathogens associated • Polymers used in textiles and antimicrobial textiles • Standard Assessment methods used in textile industries • Validation of antimicrobial technology • Developing antimicrobial textiles commercially for human welfare. 	
Unit No	Topics	Hours
Unit I	Introduction to textile microbiology History - pathogen associated with textiles - antimicrobial textiles antimicrobial agents, plant extracts, metals, disinfectants, antibiotics, biopolymers - mode of action of antimicrobials.	09
Unit II	Modification of polymers Modification methods spun-in additives and post-treatment – durable press finishing with – DMDHEU, BTCA, citric acid – advanced finishing methods – micro encapsulation methods.	09
Unit III	Antimicrobial textile preparation Antimicrobial coating methods – pad - dry - reactive dye - corona - plasma technology.	10
Unit IV	Antimicrobial assessment Standard methods (AATCC – 100, AATCC-124, AATCC-147), Chemical characterization – FTIR, topographic analysis – SEM. Physical and chemical properties of antimicrobial textiles.	10
Unit V	Validation of antimicrobial technology Antimicrobial treatment - verification – antimicrobial regulation – modern textile characterization methods – general characterization of textiles – physical, chemical resistance – thermal properties.	10

Text Book: Yuan Gao and Robin Cranston. "Recent Advances in Antimicrobial Treatments of Textiles Textile Research Journal" SAGE publications.

Reference Books

1. Rajendran, R. "Biotechnological Application in Textile Industry-Antimicrobial Textiles",. Maheswari, Industrial Exploitation of Microorganisms.
2. Edlich, R. F., Panek, P. H., Rodeheaver, G. T., Kurtz, L. D. and Edgerton, M. T., Surgical sutures and infection: A biomaterial evaluation. *Journal of Biomedical Materials Research*, 8: 115–126.
3. Gard, PR., J.P. Reynolds, G.W. Hanlon. Use of Chlorhexidine-Releasing Nylon Fibres to Reduce Device-Related Uterine Infections. *Gynecol Obstet Invest.*
4. R.C Dubey., "Textbook of Microbiology",. S. Chand and Company Ltd, New Delhi.

Code No	Subject	Semester No
16MBU22	MICROBIAL ECOLOGY	VI
Objective:	To educate the significance of microbes in the environment	
Course Outcome	On completion of the course, students learn <ul style="list-style-type: none"> • Air microflora and the different sampling methods. • Water microflora and the bacteriological examination of water samples • Soil microflora and microbial interactions • Biogeochemical cycles • Biofertilizers, SCP various types of composting and the use of microbes for biodegradation of heavy metals, xenobiotic compounds and to treat the waste water 	
Unit No	Topics	Hours
Unit I	Aerobiology Introduction to microorganisms in air – sources of microbes in air-droplet, droplet nuclei, infectious dust, factors affecting air microflora - sampling of air –settling under gravity, centrifugal action, filtration, impingement, electrostatic precipitation, air pollution.	12
Unit II	Water Microbiology Distributions of microorganism in water bodies – water borne disease - bacteriological examination of water - BOD, COD, eutrophication, waste water treatment.	12
Unit III	Soil Microbiology Factors influencing soil microbes - bacteria, fungi, actinomycetes (distributions) microbial interaction- commensalism, mutualism, syntrophism, ammensalism, parasitism and predation.	12
Unit IV	Biogeochemical cycle Nitrogen cycle, carbon cycle, phosphorus cycle, sulphur cycle - symbiotic nitrogen fixer- rhizobium and non-symbiotic, phosphate solubilizers – Mycorrhizae association – biofertilizers in agriculture.	12
Unit V	Applied Ecology Microbial decomposition- cellulose, hemicellulose, lignin, pectin and chitin- factors influencing degradation- soil waste treatment- saccharification – composting, vermi composting - bioremediation.	12

Text Book: R.R Mishra., "Soil microbiology", CBS Publishers and distributors, New Delhi.

Reference Books


1. Joseph. C Daniel., " Environmental aspects of microbiology", Brightsun Publication, London.
2. Ronald M. Atlas., "Microbial ecology Fundamentals and Applications-Richard Bartha", Pearson Publication, Germany.
3. N.S. Subba Rao., "Soil microbiology", Oxford and IBH Publication, New Delhi.
4. K.Vijaya Ramesh., "Environmental Microbiology", MJ Publishers, Chennai.

Code No	Subject	Semester No
16MBU23	GENETIC ENGINEERING	VI
Objective:	To describe general techniques used by genetic engineers to modify DNA and to analyze the benefits and drawbacks of manipulating a DNA	
Course Outcome	On completion of the course, students learn <ul style="list-style-type: none"> • To understand the importance of plasmid and viruses for genetic engineering • To analyze the different gene transfer techniques • To produce transgenic products and commercial products • To explain techniques in rDNA and to construct genomic libraries • To describe about microbial synthesis of commercial products 	
Unit No	Topics	Hours
Unit I	Restriction Enzymes and cloning vectors Outline of genetic Engineering- Nucleases: Exonucleases , Endonucleases, Restriction, RNases Methylases, Polymerases: DNA Pol I, Ligases: T4 DNA Ligase, <i>E.coli</i> DNA Ligase, desirable properties of vectors Plasmid Vectors - pSC101 & pBR322- Phage Vectors - Cosmids - Phagemids - BACs and YACs	12
Unit II	Gene Transfer Techniques Physical – biolistic method , chemical- Calcium chloride and DEAE methods , biological invitro package method - Screening and selection of recombinants- direct method – selection by complementation, marker inactivation , Indirect methods- Immunological and genetics.	12
Unit III	Transgenic plants and animals Ti plasmid – insect, virus, herbicide resistant plants – microbial insecticides – bacteria, fungi and viruses. Transgenic animals – mice – retroviral method – DNA microinjection method – embryonic stem cell method- Application- Transgenic – sheep.	12
Unit IV	Genetic engineering technique and its applications Genomic Library and cDNA Library. RAPD, RFLP, micro array and PCR applications. DNA finger printing technology, Human genome project, history and applications.	12
Unit V	Microbial synthesis of commercial products Proteins (Insulin) -Pharmaceutics – Interferons - Human growth hormone (somatostatin) - Antibiotics (cephalosporin) –Biopolymers (Xanthan gum).	12

Text Book : T.A Brown., "An introduction to Gene Cloning", Chapman and Hall, New York.

Reference Books

1. Old. RW and Primrose., "Principle of Gene Manipulation", Blackwell Scientific Publication ,Boston.
2. Winnecker, E.D., "From gene to clones, Introduction to Gene Technology", VCH Publication, FRG.
3. Bernard. R Glick and Jack J Pasternak., "Molecular biotechnology", Panima Publishing Corporation, New York.
4. U.Sathyannarayana., "Biotechnology", Books and Allied(P) Ltd., New Delhi.


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Code No	Subject	Semester No
16MBU24	MEDICAL MYCOLOGY AND PARASITOLOGY	VI
Objective:	To emphasize the knowledge of clinically important fungi and parasites	
Course Outcome	On completion of the course, students learn about: <ul style="list-style-type: none"> • Fungal characteristics, classification and mycoses • Susceptibility testing- CLSI, EUCAST methods • The life cycle and pathology of parasitic infections • Medically important helminthes. <ul style="list-style-type: none"> • Laboratory diagnostic methods 	
Unit No	Topics	Hours
Unit I	Mycoses - Superficial Characteristics of fungi- morphological classification of fungi- classification of fungal infections - superficial mycoses- surface, cutaneous infections- subcutaneous mycoses-Mycetoma, Chromomycoses, Sporotrichosis, Rhinosporidiosis.	12
Unit II	Systemic Mycoses Systemic Mycoses –Histoplasmosis, Blastomycosis, Coccidioidomycoses, Opportunistic Mycoses- Cryptococcosis, <i>Candida albicans</i> , Aspergillosis and Penicilliosis. Antifungal agents- Antifungal susceptibility testing- CLSI, EUCAST methods.	12
Unit III	Protozoology Introduction of protozoa- Morphology, life cycle, pathology - <i>Entamoeba histolytica</i> , Intestinal flagellates- <i>Giardia lamblia</i> , Genital flagellate- <i>Trichomonas vaginalis</i> , Hemoflagellates- <i>Leishmania donovani</i> , Tissue flagellate- <i>Toxoplasma gondii</i> Malarial parasite- <i>Plasmodium vivax</i> and <i>Coccidia- Cryptosporidium parvum</i> .	12
Unit IV	Helminthology Helminthology- Medically important helminthes- Tapeworms- <i>Taenia solium</i> , <i>Taenia saginata</i> , Trematodes- <i>Schistosoma haematobium</i> ; <i>Fasciola hepatica</i> ; Nematodes- <i>Ascaris lumbricoides</i> , <i>Wuchereria bancrofti</i>	12
Unit V	Laboratory Methods for fungi and Parasites Collection of specimen - wet mount, KOH and LPCB and fungal culture -- Collection of specimen - Preservation and examination of stool- macroscopic and microscopic examination, Concentration methods- floatation- sedimentation techniques, duodenal contents, anal swabs, blood- thin and thick smear- staining and cerebrospinal fluid.	12

Text Books : Subash Chandra Parija., "Textbook of Medical Parasitology protozoology and Helminthology", All India Publishers and Distributors, New Delhi.

Reference Books

1. Ananthanarayan and Jayaram Paniker., "Textbook of Microbiology", University Press India Pvt Ltd, New Delhi. Talib. V.H., "Handbook of Medical Microbiology". CBS Publishers, New Delhi.
2. Rajesh Karyakarte and Ajith Damle., "Medical Parasitology", Books and Allied(P)Ltd, .New Delhi
3. Mackie and Mc catney., "Medical Microbiology No I and II". Churchill Livingston, 14th edition, New Delhi.
4. Bailey and Scotts., "Diagnostic Microbiology", 9th edition, Baron and Finegold CV Mosby Publications, New York.

Code No	Subject	Semester No
16MBU25	ENTREPRENEURSHIP IN MICROBIOLOGY	VI
Objective:	To develop and strengthen the entrepreneurial quality in Microbiology	
Course Outcome	On completion of the course, students <ul style="list-style-type: none"> • Have the ability to discern distinct entrepreneurial traits • Know the parameters to assess opportunities and constraints for new business ideas in Biology • Develop the skills for product development. • To define, identify and/or apply the principles of entrepreneurship • Learn about Indian and global patents. 	
Unit No	Topics	Hours
Unit I	Evolution of the concept of entrepreneur Entrepreneurship: concept of Entrepreneurship, development – need – role of resource, talent and spirit – process of entrepreneurship to socio-economic gains	12
Unit II	Institutions and schemes of government of India Schemes and programmes, Department of science and technology schemes, Nationalized banks – other financial institutions etc., – SFC-NSIC-SSIC-SIDBI-DIC-TAHDCO-CODISSIA-SID-MSME and commercial banks etc.,	12
Unit III	Skills for entrepreneurs Communication skills, problem solving skills; Business plan development; Market need – market research, SWOT analysis, identify your competition. Financial plan – obtain financing for your business, insure your business, Marketing – mix-product, distribution, price, promotion, set marketing goals	12
Unit IV	Small scale entrepreneurship Biocomposting- Domestic waste, agricultural and industrial waste-vermi – composting. SCP production – mushroom cultivation. Biofertilizers and Biopesticides. Development of diagnostic and research kits (plasmid DNA isolation, serum electrophoresis, WIDAL test kits, ABO blood grouping kits)	12
Unit V	Patenting and Open Source IPR History of patenting, characteristics of a patent, composition, subject matter and, Inventor, Infringement, cost of patent. Patents in India and other countries- Open source and commercial software-WIPO.	12

TextBook: S.L Gupta., "Entrepreneurship Development", International Book house, India

Reference Books

1. Ronald M Atlas and Richard Bartha., "Microbial Ecology", Pearson publication, Germany.
2. Greene., "Entrepreneurship ideas in action", Thomson learning, New York.
3. Anil kumar S., "Entrepreneurship Development", New Age International, India.
4. Satyanarayana U., "Biotechnology", Books and Allied P Ltd, Kolkata, India.

Code No	Subject	Semester No
16MBU25	LARGE SCALE MANUFACTURING PRACTICES	VI
Objective:	To emphasis the knowledge of large scale manufacturing process	
Course Outcome	On completion of the course, students learn <ul style="list-style-type: none"> • To describe the types of fermentation processes • To improve the strain for Industrial production. • About design of Bioreactors • To analyze different media in fermentation. • To gain knowledge about quality control and assurance in finished product. 	
Unit No	Topics	Hours
Unit I	Fermentation Definition, Historical perspective, Lay out of a typical fermentation unit - Types of fermentations - Submerged, Surface, Solid State, Dual, Batch, Continuous, Fed Batch- Screening- Definition and Objectives - Primary and Secondary Screening.	12
Unit II	Strain Improvement Objectives - Methods for strain improvement with examples (mutant selection, mutants with altered permeability, auxotrophic mutants, analogue resistant DNA technology) - Microbes of industrial importance, Culture collection centers of industrially important microorganisms - Inoculum build up for Industrial fermentations - Bacteria and Fungi.	12
Unit III	Bioreactor Design Characteristics of an ideal Fermenter- Construction material used-surface treatment of material Design of a typical Batch Fermenter Aerator and Agitator- types, Baffles, Seals and valves used, steam traps - Additional accessories and peripherals.	12
Unit IV	Media used for large scale production Carbon sources - Cane and Beet molasses, Malt, Corn, Starch, oils, hydrocarbons, alcohols. Nitrogen sources - Corn steep liquor, Soybean meal, peanut meal Buffers Chelators Water Precursors, Inhibitors, Inducers Antifoams- types, mode of action, advantages and disadvantages. Inoculum and Production media Media for animal cell culture.	12
Unit V	Quality assurance and Validation Concept of Good Manufacturing Practices (GMP) -Standard Operating Practices(SOP) - Quality Control and Quality Assurance (Definition, Functions and Responsibilities) - Tests Used for Quality Assurance of finished product- Sterility Testing - Pyrogen testing - Bacterial endotoxin (LAL test) - Ames Test	12

Text Books: A.H. Patel., "Industrial Microbiology", Macmillan India Publishers, New Delhi.

Reference Books

1. Stanbury P T and Whitaker., " Principles of Fermentation Technology", Pergamon Press, New York.
2. Casida, L E JR., "Industrial Microbiology", New Age International Publishers, New Delhi.
3. Prescott and Rehm., " Industrial Microbiology", Wiley and Sons, France.
4. Nduka Okafor., "Modern Industrial Microbiology and Biotechnology", CRC Press, New Delhi.

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Code No	Subject	Semester No
18MBU25	BIOETHICS, IPR AND BIOSAFETY	VI
Objective:	To help students understand the ethical, social, legal aspects in biology and the biocontainment	
Course Outcome	On completion of the course, students learn about <ul style="list-style-type: none"> • The ethical values in Microbiological Research • The ethics in usage of animal and human specimens for Research • Patenting in Biological research • Biosafety in applying genetically modified organisms • Biosafety guidelines 	
Unit No	Topics	Hours
Unit I	Bioethics Bioethics – Social, Legal, and Ethical issues in biotechnology, Bioethics committees Rules for the manufacture, use/import/export and storage of hazardous microorganisms/genetically engineered organisms or cells (Ministry of Environment and Forests Notification, 1989). Public education of the process of biotechnology involved in generating new forms of life for informed decision-making – ethical concerns of biotechnology research and innovation.	12
Unit II	Animal Ethics Animal ethics - Norms in India-Licensing of animal house - Ethical clearance norms for conducting studies on human subjects, IAEC	12
Unit III	IPR and Human relations IPR – patents- other forms of IPR (Copyright - Trademark – Designs), Farmer’s rights – WTO – GATT. Patentable subjects and protection in biotechnology-The patenting of living organisms.	12
Unit IV	Biosafety Protocols Biosafety for human health and environment. - Global scenario of transgenic microorganisms and plants. Biosafety Committee (IBC), Review Committee on Genetic Manipulation, Genetic Engineering Approval Committee (GEAC), State Biosafety Coordination Committee (SBCC), District Level Committee (DLC). Ecological risk of engineered microorganisms/plants and remedial measure.	12
Unit V	Biosafety Guidelines Biosafety guidelines for research - Containment facilities (physical and biological) - Advantage and disadvantage of genetically modified organisms and genetically modified foods- GLP and GMP.	12

Text Books : Raj mohan Joshi., “Biosafety And Bioethics”, Gyan books pvt.lmt., Bangalore.


Reference Books

1. Beier, F.K., Crespi, R.S. and Straus, T. Biotechnology and Patent protection-Oxford and IBH Publishing Co. NewDelhi.
2. Sasson A, Biotechnologies and Development, UNESCO Publications.
3. Singh K, Intellectual Property rights on Biotechnology, BCIL, New Delhi.
4. Regulatory Framework for GMOs in India (2006) Ministry of Environment and Forest, Government of India, New Delhi
5. Cartagena Protocol on Biosafety (2006) Ministry of Environment and Forest, Government of India, New Delhi

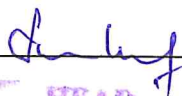
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Department of Microbiology
Rasthathan College of Arts & Science
Coimbatore - 641 028

Code No	Subject	Semester No
18MBU26	PRACTICAL IV LAB IN BIOINFORMATICS	VI
Objective:	To impart practical knowledge on Bioinformatics	
Course Outcome	On completion of the course, students learn about: <ul style="list-style-type: none">• Exploring data from the web resources• Applying Bioinformatics tools• Biological databases, sequence retrieval, similarity search and gene prediction• Predicting sequences	
LIST OF EXPERIMENTS		
<ol style="list-style-type: none">1. Visit NCBI, Explore and List out the salient features.2. Visit EMBL, Explore and List out the salient features.3. Visit DDBJ, Explore and List out the salient features.4. Retrieve protein sequence for tyrosinase and find out if this protein is present in <i>Agaricus bisporus</i> using BLAST P and 'limit by entrez' query option5. Similarity search- Get any two sequence in FASTA format6. Use ORF finder of NCBI to predict all possible ORF in a DNA sequence7. Use MOTIF search and PROTPARM tools		


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Code No	Subject	Semester No
18MBU27	PRACTICAL III VIROLOGY, r DNA, INDUSTRIAL, FOOD AND ENVIRONMENTAL MICROBIOLOGY	V & VI
Objective:	To impart practical knowledge on virology, r DNA, Industrial, Food and Environmental Microbiology	
Course Outcome	On completion of the course, students will develop skill regarding: <ul style="list-style-type: none"> • Isolation of coliphages from sewage • Techniques used in industrial production of organic acids, enzymes and alcohol • Enumeration, Detection and confirmation of pathogens from food • Test for milk quality • Various methods used in agriculturally important microbes • Tests in waste water treatment 	
LIST OF EXPERIMENTS		
<ol style="list-style-type: none"> 1. Enzyme production and assay <ol style="list-style-type: none"> a) Protease b) Amylase 2. Production of organic acid- citric acid by submerged fermentation. 3. Alcohol production / wine- alcohol, acid and sugar estimation 4. Immobilization of cells 5. Methylene blue reduction test 6. Enumeration of aerobic bacteria and fungi in food- Bread and vegetables 7. Detection and confirmation of pathogens from food- Salmonella and <i>Staphylococcus aureus</i> 8. Determination of sterility of canned foods- Fermentation test 9. Direct microscopic examination of curd – observation of Lactobacillus sp. 10. Isolation of coliphages from sewage. 11. Isolation of free living nitrogen fixers –<i>Azotobacter</i>, <i>Azospirillum</i> 12. Isolation of symbiotic nitrogen fixer -Rhizobium 13. Isolation of ammonifiers, nitrifiers and denitrifiers 14. Isolation of Phosphate solubilizers 15. Estimation of biological oxygen demand (BOD) 16. Estimation of COD 17. MPN Technique – Detection of potability of water 18. Competent cell preparation & Transformation. 19. Cultivation of Azolla 		



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