MADURAI KAMARAJ UNIVERSITY

DEPARTMENT OF MICROBIAL TECHNOLOGY
SCHOOL OF BIOMEDICAL SCIENCES

SYLLABUS FOR
M.Sc., MICROBIAL GENE TECHNOLOGY COURSE
(A Self-financing course)

(2020- 2021 onwards)

CHOICE BASED CREDIT SYSTEM (CBCS)

Submitted To

The Coordinator
CBCS office
Madurai Kamaraj University
Madurai – 625 021

Submitted by

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MADURAI KAMARAJ UNIVERSITY

APPENDIX – C

MADURAI KAMARAJ UNIVERSITY

***(University with potential for excellence*)**

SYLLABUS FOR
M.Sc. MICROBIAL GENE TECHNOLOGY DEGREE COURSE
(A Self-Financing Course)

CHOICE BASED CREDIT SYSTEM (CBCS)
(Effect from the academic year 2018-2019 onwards)

Name of the Course:

The course is named M.Sc., Microbial Gene Technology incorporates both cores, elective and soft skill papers as its components. The syllabus for this course is framed under the regulations of the Choice Based Credit System of this University.

Course features

The course is organized on a semester basis with a total of four semesters. In the first three semesters the students will be doing three theories and one practical core paper. Fourth semester is for project work and research methodology paper. For every semester the students must choose one elective and one soft skill paper on their choice. A list of subjects, their codes, credits and marks of evaluation are compiled in the table.

Regulations

1. Eligibility for admissions

A. Those who have completed B.Sc. Degree examination of the Madurai Kamaraj University and all other states and central university of India and aborad with Microbiology, Biotechnology, Botany, Zoology, Biology, Physics, Chemistry, Biochemistry, Agriculture, Nutrition & Diabetics as major subjects or an examination accepted as equivalent or an examination accepted as equivalent there to by the syndicate.

B. The admission is subject to the prevailing rules and regulations for PG admission of this University. The candidate has to undergo this course in the Department of Microbial Technology, School of Biomedical Sciences, Madurai Kamaraj University and complete all the examinations prescribed under the four semesters to qualify this degree.

C. Total number of seats: **20 + 5 (NRI or Bio entrepreneurship Quota)**

2. Processing of application:

Applicants are expected to take a national level entrance test followed by Viva presentation. Selection of candidates would be based purely on merit and weightage would be given to State Government Policy in the final selection of students.

3. Duration of the course

The students will undergo the prescribed course of study for a period of not less than two academic years (four semesters)

4. Medium of Instruction: English

5. Subjects of study &Scheme of Examinations: As given in Appendix A

6. Eligibility for the degree: Candidate will be eligible, provided he/she completes the course and pass in the prescribed examinations.

7. Guidelines regarding pass minimum:

To get a pass, should fulfill the following conditions:

A) Theory:

1. 50% of the aggregate (External + Internal).
2. No separate pass minimum of internal
3. 34 marks out of 75 is the pass minimum for the External.

B) Practicals:

1. 50% of the aggregate (External + Internal)
2. No separate pass minimum for the internal
3. 27 marks out of 60 is the pass minimum for the External.

C) Project:

1. 50% of the aggregate (project evaluation + Viva-voce)
2. No separate pass minimum for the viva-voce
3. 34 marks out of 75 is the pass minimum for the project evaluation.

8. Question paper pattern

The existing pattern of question paper will be as follows:

Time: 3 hours Max Marks: 75

Section A: (10 x 1 =10)

Question No 1 to 10

1. Two questions from each unit.
2. Four choices in each question.
3. Answer all questions. Choose the right answer.

Section B: (5 x 7= 35 marks)

Answer all questions - Either OR types

Answer not exceeding two pages.

(One question from each unit)

Question Nos.
11a or 11b
12a or 12b
13a or 13b
14a or 14b
15a or 15b

Section C: (3 x 10 = 30 marks)

Answers not exceeding four pages

Answer any **THREE** out of Five (one question from each unit)

Question Nos.- 16-20

The pattern for internal valuation may be:

a) Two internal tests of 15 marks each: Average = 15 marks
b) Group discussion/ Seminar/ Quiz = 05 marks
c) Two assignments: %marks each: Average = 05 marks

c) Practical Exams: External (MAX: 60 Marks)

One Major Experiment	= 20 marks
One Minor Experiment	= 10 marks
Two spotters	= 05 marks
Record Book	= 05 marks
Viva Voce	= 20 marks

The pattern for **internal valuation** for 40 marks may be:

d) Two internal tests of 25 marks each: average = 25 marks

e) Observation book = 10 marks
f) One assignment = 05 marks

d) **Project evaluation: (MAX 100 Marks)**

External max: 75
Dissertation work = 60 marks
Presentation and viva = 15 marks
Internal max: 25 marks = (decided by the guide)

Restriction to complete the course:
In order to qualify for the degree, a candidate should complete all the prescribed Theory/Project examinations and secure a minimum of 64 credits in the core examination, 16 credits in elective and 10 credits in SSS course within a minimum period of two years and maximum period of five years counting from the date of admission to the course.

Declaration of result:

A candidate should get a minimum of 64 credits in the core examination, 16 credits in elective and 10 credits in SSS course in aggregate should secure 90 credits to pass. On successful completion of the PG programme, a candidate will be declared to have passed the exam with class and grade points that is computed on the basis of cumulative weighted average marks obtained in percentage.

Fees structure

1st Year

Tuition fee	-	15,000/-	**A/c.No.I**
Lab fee	-	29,000/-	
Special fee	-	1,790/-	
Other fees to be paid at the time of admission	-	100/-	
CBCS Hand Book	-	100/-	
Students' Aid fund	-	10/-	**A/c.No.III**
Caution Deposit (Refundable)	-	1,000/-	**A/c.No.IV**
Alumni fees	-	500/-	
Total		47,500/-	

2nd Year

Tuition fee	-	15,000/-	**A/c.No.I**
Lab fee	-	29,000/-	
Special fee	-	1,790/-	
Other fees to be paid at the time of admission	-	100/-	
CBCS Hand Book	-	100/-	
Students' Aid fund	-	10/-	**A/c.No.III**
Total		46,000/-	

NRI Students Fees Structure

1st Year

Tuition fee	-	400 US $	**A/c.No.I**
Lab fee	-	850 US $	
Special fee	-	40 US $	
Other fees to be paid at the time of admission	-	15 US $	
CBCS Hand Book	-	10 US $	
Students' Aid fund	-	05 US $	**A/c.No.III**
Caution Deposit (Refundable)	-	50 US $	**A/c.No.IV**
Alumni fees	-	30 US $	
Total		1400 US $	

2nd Year

Tuition fee	-	400 US $	**A/c.No.I**
Lab fee	-	850 US $	
Special fee	-	40 US $	
Total		1290 US $	

APPENDIX – A

CHOISE BASED CREDIT SYSTEM (CBCS)

M.Sc., DEGREE COURSE IN MICROBIAL GENE TECHNOLOGY

COURSE SCHEME AND SCHEME OF EXAMINATIONS

(For those admitted in June 2018 and after)

Subject code	Title of the Paper	Core/ Elective	Hours/ Week	No. of credits	Exam hours	Marks		
						Int.	Ext.	total
I Semester								
MGT01	Bacteriology	C	3	4	3	25	75	100
MGT02	Microbial Biochemistry	C	3	4	3	25	75	100
MGT03	Molecular Biology	C	3	3	3	25	75	100
MGT04	Lab in General Microbiology & Microbial Biochemistry	C	15	4	6	40	60	100
MGT05	Lab in Molecular Biology	C	15	4	6	40	60	100
	Elective	E	3	4	3	25	75	100
	SSS course	S	3	2	3	25	75	100
	Total		**30**	**25**				**700**
II Semester								
MGT06	Bioresource Technology	C	3	4	3	25	75	100
MGT07	Fundamentals of Immunology	C	3	3	3	25	75	100
MGT08	Medical Mycology and Parasitology	C	3	4	3	25	75	100
MGT09	Lab in Industrial Microbiology	C	9	4	3	25	75	100
MGT10	Lab in Medical Microbiology and Immunology	C	9	4	6	40	60	100
	Elective	E	3	4	3	25	75	100
	SSS course	S	3	3	3	25	75	100
	Total		**30**	**26**				**700**
III Semester								
MGT11	Environmental Microbiology	C	3	4	3	25	75	100
MGT12	Food Microbiology	C	3	4	3	25	75	100
MGT13	rDNA Technology	C	3	3	3	25	75	100
MGT14	Lab in Environmental Microbiology and Food Microbiology	C	9	4	6	40	60	100
MGT15	Lab in rDNA Technology	C	6	4	3	40	60	100
	Elective	E	3	4	3	25	75	100
	SSS course	S	3	2	3	25	75	100
	Total		**30**	**25**				**700**
IV Semester								
MGT16	Virology	C	3	3	3	25	75	100
MGT17	Project and viva -voce	C	21	4	-	25	75	100
	Elective	E	3	4	3	25	75	100

	SSS course	S	3	3	3	25	75	100
	Total		**30**	**14**				**400**
	Grand total			**90**				**2500**

Electives offered for Parent Department/ for other department

SEMESTER-I MGTE01: Medical Microbiology (or) MGTE02: Mycology and Phycology	 4 4	 4 credits 4 credits
SEMESTER-II MGTE03: Fermentation Technology (or) MGTE04: Microbial diversity and Extremophiles	 4 4	 4 credits 4 credits
SEMESTER-III MGTE05: Microbial "Omics" (or) MGTE06: Microbial Technology	 4 4	 4 credits 4 credits
SEMESTER-IV MGTE07: Microbial Genomics (or) MGTE08: Microbial Molecular Diagnostics and Therapeutics	 4 4	 4 credits 4 credits

Soft skill courses offered for Parent Department/ for other department

SEMESTER-I & SEMESTER-III MGT NE01 – Microbial Nanotechnology MGT NE02 - Developmental Biology	 3 credits 3 credits
SEMESTER-II & SEMESTER-IV MGT NE03 – Ecology &Evolutionary Biology Bioremediation MGTNE04 - Proteomics	 3 credits 3 credits

SEMESTER – I

Course Code: MGT01 **BACTERIOLOGY** **Credits - 4**
Hours - 3

Scope
This paper provides a thorough knowledge in principles and functions of microorganisms, Microbial physiology and Microbial products.

Course Objectives:

- To learn the basic concepts and classification Microorganisms
- To understand the basic fundamentals of Microbial physiology.
- To gain knowledge of the basic principle of the fermentation process and microbial products

Unit I: Classification and Morphology of microbes

Classification of micro organisms - introduction - Haeckel's three kingdom concept - Whittaker's five kingdom concept - three domain concept of Carl Woese, Basis of microbial classification, Classification and salient features of bacteria according to the Bergey's manual of determinative bacteriology, cyanobacteria, prochlorons and cyanelles. Morphology and ultra structure of bacteria - morphological types - cell walls of archaebacteria - gram negative - gram positive eubacteria - eukaryotes, L-forms - cell wall synthesis, antigenic properties - capsule - types, composition and function, cell membranes - structure - composition
- properties.

Unit II: Cell structure and Function

Periplasmicspace. Structure and function of flagella, cilia and pili, gas vesicles, chlorosomes, carboxysomes, magnetosomes and phycobilisomes. Cytoplasmic inclusions, mesosomes. Structure, biochemistry and genetics of sporulation. General account on Mycoplasma and Actinobacteria. Biology of yeast – reproduction: virus (bacteriophages) structure, life cycle (lytic and lysogenic) – Mycoplasma – prions

Unit III: Microbial growth

Microbial growth measurements - cell count - turbidity measurement - percentage transmission, Optical Density - serial dilution - standard plate count. Cultivation of bacteria - aerobic - anaerobic - shaker - still - nutirional types - culture media used - growth curve - generation time - growth kinetics - asynchronous - synchronous – batch - continuous culture - measurement of growth and factors affecting growth,control of bacteria - physical and chemical agents - preservation methods.

Unit IV: Microbial Products

Antibiotics, amino acids, organic acids; special compounds for use in Medicine and Health-Biopolymers, Plant growth hormone production from bacteria and fungi, Biofuel, Biosurfactants and Bioconversion; Biodegradation, Bioremediation-microbial mining- and Bioaugmentation, Microbes as Products-Nanotechnology, Biosensors, Biofertilizers, Biopesticides.

Unit: V: **Microbial physiology**

Osmotic stress – Oxidative stress – Nitrate response – Nutrient response – pH stress – Heat shock response – Nutrient stress and starvation stress – Extremophiles. Two components signal transduction – Regulation of nitrogen assimilation- Nitrogen fixation-*Rhizobium leguminosarum* and VAM, Phosphate transport system – Quorum sensing.

References:

1. Pelczar M.J., Chan E.C.S, Kreig N.R. Microbiology, Mc Graw Hill.
2. Albert G Moat, John W. Foster, Micheal P. Spector. 2002. Microbial Physiology (4th Edition) John Wiley & Sons, Inc., Publication.
3. Willey,J.M., Sherwood,L., Woolverton, C.J.,2008. Prescott, Harley and Klein. Microbiology [7th Edition], McGraw-Hill Higher Education publications.
4. Ananthanarayanan and Jeyaram Paniker C.K. 2009. Text Book of Microbiology, 8th Edition, Orient Longman, Chennai.

COURSE OUTCOME:

After completing this course, students will

CO1. Understand the basic microbial structure and similarities and differences among various groups of bacteria.

CO2. Describe the structure and functions of bacteria.

CO3. Demonstrate the microbial growth kinetics

CO4. Analyze bioprocess technology for the commercialization of microbial products.

CO5. Evaluate the metabolism and growth under normal and stressed conditions.

Cognetive Level

MGT01: BACTERIOLOGY			
Class	I M.Sc, MGT	Semester	I
Cognitive Level	K-1	Understand	20
	K-2	Describe	20
	K-3	Demonstrate	20
	K-4	Analyze	20
	K-5	Evaluate	20

Mapping

MGT01: BACTERIOLOGY															
CO/PO	**PO**					**PSO**									
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
CO1	**3**	**2**	**3**	**2**	**3**	**3**	**1**	**2**	**2**	**3**	**2**	**3**	**2**	**3**	**2**
CO2	**3**	**2**	**3**	**3**	**3**	**2**	**3**	**2**	**2**	**2**	**2**	**1**	**2**	**1**	**2**
CO3	**2**	**3**	**2**	**3**	**3**	**3**	**1**	**3**	**2**	**2**	**1**	**2**	**1**	**1**	**3**
CO4	**2**	**3**	**2**	**3**	**3**	**2**	**1**	**3**	**2**	**2**	**3**	**1**	**2**	**1**	**3**
CO5	**3**	**3**	**3**	**2**	**3**	**2**	**2**	**3**	**2**	**3**	**2**	**2**	**3**	**3**	**2**

3 - Strongly Correlated; 2 - Moderately Correlated; 1 - Weakly Correlated

Course Code: MGT02 MICROBIAL BIOCHEMISTRY **Credits - 4**
Hours - 3

Scope

This paper provides the knowledge on principles and methods in microbial metabolism, microbial nutrition and bioenergetics.

Course Objective:

- To understand the basic concepts of Biochemistry.
- To study the various metabolic pathways and macromolecules structure and their functions.
- To learn the basic concepts and classification of enzymes

Unit I: Introduction to Biochemistry

Scope and importance of biochemistry; Atomic Nucleus-Isotopic-Bonding, Acid-base concept and buffers; pH; Hydrogen bonding; Ionic, metallic, Covalent; Hydrophobic, Electrostatic and Vander Waals forces. Thermodynamic principles and biological processes; Bioenergetics. Biomolecules - structure, classification, properties, biological functions and importances.

Unit II: Microbial Nutrition

Microbes- Structure, characteristics and classification. Bacterial cell wall - structure and function. Microbial nutritional Interaction:- Nutritional Categories of microorganisms based on carbon; energy and electron sources. Phototrophs, Chemotrophs, Autotrophs, Heterotrophs, Lithotrophs and Organotrophs. Enteral nutrition: variable nutrient and prebiotic compounds Metabolite Transport: Diffusion: Passive and facilitated; Primary and secondary active transport; Group translocation (Phosphotransferase system) electro neutral transport; transport of Iron. Photosynthesis-oxygenic-anoxygenic photosynthesis; fixation of CO_2- Calvin cycle - C3-C4 pathway. Chemolithotrophy-methanogenesis; luminescence.

Unit III: Energy metabolism

Anabolism-Catabolism- Embden-Mayer Hoff pathway - Entner Doudroff pathway - glyoxalate cycle - Krebs cycle – oxidative and substrate level phosphorylation - reverse TCA cycle; HMP shunt; Electron transport chain. Biosynthesis of Starch, cellulose, agar agar and peptidoglycan. Role of lipids in cellular architecture and functions. Oxidation of Fatty acids, Biosynthesis of MUFA and PUFA and their regulation. Significance of energy metabolism.

Unit IV: Microbial Macromolecule Metabolism

Structure and metabolism of amino acids. Nucleic acids-Structure-biosynthesis and catabolism of nucleotides. Fatty acid metabolism in bacteria. Microbial Properties and enzyme mechanisms of carbiohydrate, lipids and proteins Fermentation: Alcoholic, Lactic acid, Mixed acid

fermentations: Butanediol, different pathways steps of fermentation: *E. coli* and *Enterobacter aerogenes* Catabolism of bio macromolecules and bio-polymers.

Unit V: Microbial Enzymes and Vitamins Metabolism:

Classifications and Chemical properties of microbial enzymes-Substrate specificity, kinetics-Catalytic efficiency- Bisubstrate reactions and Rate equations. Lysozyme- enzyme structure-catalytic mechanism. Regulation of enzyme activity- importance of compartmentation- Applied Enzymology- Immobilized enzymes- Industrially important enzymes: proteases, xylanases-pectinolytic enzymes, cellulolytic and chitinolytic enzymes. Vitamins-properties, co-factors and co-enzymes.

References:

1. Lehninger, A.L., Nelson.D.L., Cox., M. M.2005 Lehninger Principles of Biochemistry, 5th ed. W. H. Freeman.
2. Berg.J.M, Tymoczko.J.L, Stryer, L. , 2006. Biochemistry (6th ed). Freeman.
3. Murray,R.K., Rodwell,V.W., Bender, D., Botham, K.M., Weil, P.A. and Kennell, P.J. 2009. Harper's Illustrated Biochemistry, 28th Edition, McGraw Hill Professional publications.
4. Voet,D. and Voet, J.G. 2010. Biochemistry (4rd ed.) John Wiley & Sons.

COURSE OUTCOME:

Upon the successful completion of the course, the student will be able to:

- **CO1.** Knowledge about basics of Biochemistry with various properties of biomolecules such as metabolic, chemical and biological properties.
- **CO2.** Discuss the microbial nutrition and different types of transport and photosynthesis mechanisms
- **CO3.** Explain the various metabolic pathways involved in micobes
- **CO4.** Survey the primary metabolites and microbial fermentation
- **CO5.** Learn in detail on the enzyme kinetics and application of microbial enzymes

Cognetive Level

MGT02: MICROBIAL BIOCHEMISTRY			
Class	I M.Sc, MGT	Semester	I
Cognitive Level	K-1	Knowledge	20
	K-2	Understand	20
	K-3	Apply	20
	K-4	Analyze	20
	K-5	Evaluate	20

Mapping

MGT02: MICROBIAL BIOCHEMISTRY															
CO/PO	**PO**					**PSO**									
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
CO1	**1**	**2**	**3**	**3**	**2**	**1**	**1**	**2**	**3**	**2**	**1**	**1**	**2**	**2**	**3**
CO2	**2**	**1**	**3**	**2**	**3**	**1**	**1**	**2**	**3**	**2**	**1**	**1**	**2**	**2**	**3**
CO3	**1**	**3**	**2**	**2**	**2**	**1**	**1**	**2**	**3**	**1**	**1**	**1**	**2**	**2**	**3**
CO4	**1**	**2**	**3**	**2**	**2**	**1**	**1**	**2**	**3**	**1**	**1**	**1**	**2**	**2**	**3**
CO5	**3**	**1**	**2**	**2**	**3**	**1**	**3**	**2**	**2**	**3**	**1**	**1**	**3**	**1**	**2**

3 - Strongly Correlated; 2 - Moderately Correlated; 1 - Weakly Correlated

Course Code: MGT 03 MOLECULAR BIOLOGY **Credits - 3**
Hours - 3

Scope

This paper provides a thorough knowledge in principles and methods in gene mining, gene cloning and molecular tools used for genetic manipulation.

Course Objective:

- To understand the molecular basis of nucleic acids and biological processes
- To study the process of replication and DNA repair mechanisms
- To understand the transcriptional, translational and other molecular regulations in prokaryotes and eukaryotes

Unit I: Nucleic acids

Nucleic acids as genetic information carriers: experimental evidence. DNA structure: historical aspects and current concepts, melting of DNA. DNA replication: general principles, various modes of replication, isolation and properties of DNA polymerases, proof reading, continuous and discontinuous synthesis. Asymmetric & dimeric nature of DNA polymerase III and simultaneous synthesis of leading and lagging strands, DNA polymerase, exonuclease activity in eukaryotic DNA polymerases. Superhelicity in DNA, linking number, topological properties, mechanism of action of topoisomerases. **Gene transfer in Bacteria- transformation-conjucation and transduction**

Unit II: DNA replication and repair mechanisms

Initiation of replication of single stranded DNA. Construction of replication fork in test tube. Retroviruses and their unique mode of DNA synthesis. Relationship between replication and cell cycle. Inhibitors of DNA replication (blocking precursor synthesis, nucleotide polymerization, altering DNA structure). DNA damage and repair: types of DNA damage (deamination, oxidative damage, alkylation, pyrimidine dimers). Repair pathways — methyl-directed mismatch repair, very short patch repair, nucleotide excision repair, base excision repair, recombination, repair, SOS system. Inhibition of DNA replication. Gene cloning in bacteria, Construction of genomic and cDNA libraries, Transposons. Screening of recombinants – Phenotypic expression of characters

Unit III: Transcription process in Prokaryotes and Eukaryotes

Structural features of RNA (rRNA, tRNA and mRNA) and relation to function. Initiator and elongator class of tRNA, ribosome binding site on mRNA and corresponding site on rRNA, peptidyl transferase activity of 23S rRNA. RNA and peptide nucleic acid (PNA). Transcription: various factors involved in transcription process- general principles, basic apparatus, types of RNA polymerases, steps: initiation, elongation and termination, inhibitors of RNA synthesis. Regulatory elements of transcription. Inhibitors of transcription - Polycistronic and monocistronic RNAs. Control of transcription by interaction between RNA polymerases and

promoter regions, use of alternate sigma factors, controlled termination: attenuation and antitermination.

Unit IV: Regulation of gene expression

Regulation of gene expression: operon concept, catabolite repression, instability of bacterial RNA, positive and negative regulation, inducers and corepressors. Negative regulation - E. coli lac operon; positive regulation - *E. coli* ara operon; regulation by attenuation - his and trp operons; antitermination - N protein and nut sites in l. DNA binding proteins, enhancer sequences and control of transcription. Identification of protein- binding sites on DNA. Global regulatory responses:heat shock response, stringent response and regulation by small molecules such as ppGpp and cAMP, regulation of rRNA and tRNA synthesis.
Genetically modified organisms (GMO's). Gene silencing – Gene knockouts and gene therapies, antisense technologies. Genetic engineering of plants for viruses, herbicide tolerance.

Unit V : Translation
Basic features of the genetic code. Protein synthesis: steps, details of initiation, elongation and termination, role of various factors in the above steps, inhibitors of protein synthesis. Synthesis of exported proteins on membrane-bound ribosomes, signal hypothesis. In vitro transcription and translation systems. Post translation modifications- Wobble hypothesis.

References:

1. Freifelder, D. 1990. Essentials of Molecular Biology. Narosa Publishing House, New Delhi.
2. Lodish, H., Berk,A., Matsudaira,P., Baltimore, D., Zipursky, S.L and Darnel, J. 1995. Molecular Cell Biology. W.H. Freeman, New York
3. Krebs, J.E., Goldstein, E.S., and Kilpatrick, S.T. 2017. Lewin's Genes XII. Jones & Bartlett Learning, Burlington.
4. Molecular cell biology (W.H.Freeman) by Lodish, Berk, Zippursky.

COURSE OUTCOME:

Upon completion of the course, the student would

- **CO1.** Gain comprehensive knowledge in Molecular Biology,
- **CO2.** Discuss the mode of replication and its molecular mechanisms
- **CO3.** Explain the process of transcription, translation and gene expression
- **CO4.** Analyze the regulation of protein synthesis

Cognetive Level

MGT 03: MOLECULAR BIOLOGY			
Class	I M.Sc, MGT	Semester	I
Cognitive Level	K-2	Knowledge	30
	K-3	Understand	30
	K-4	Analyze	20
	K-5	Evaluate	20

Mapping

MGT 03: MOLECULAR BIOLOGY															
CO/PO	**PO**					**PSO**									
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
CO1	**3**	**2**	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**3**	**2**	**1**	**3**	**2**	**3**
CO2	**3**	**2**	**3**	**3**	**3**	**3**	**2**	**2**	**2**	**3**	**2**	**1**	**3**	**2**	**3**
CO3	**3**	**2**	**3**	**3**	**3**	**3**	**2**	**2**	**2**	**3**	**2**	**1**	**3**	**2**	**3**
CO4	**3**	**2**	**3**	**3**	**3**	**3**	**2**	**2**	**2**	**3**	**2**	**1**	**3**	**2**	**3**

3 - Strongly Correlated; 2 - Moderately Correlated; 1 - Weakly Correlated

Course Code: MGT 04 Lab in General Microbiology and Microbial Biochemistry **Credits - 4**
Hours - 15

Course Objective:

- Understand the basic equipments, maintenance of aseptic environment and cleaning process in laboratory
- To prepare the media for microorganisms and separation techniques
- To perform various biochemical and physiological analysis of microbes
- To prepare buffers and study the chemical nature of the solutions

1. Observation of various types of microbes under simple, light, phase contrast, and fluorescence
2. Sterilization techniques
3. Media preparation – Liquid and solid.
4. Pure culture techniques: streak plate, pour plate and spread plate method.
5. Motility determination – Hanging drop method.
6. Staining – Simple, Gram's, Acid-fast, spore capsule staining, and Lactophenol cotton blue, Lugol's staining
7. Isolation of fungi from soil sample
8. Isolation of microalgae from pond water
9. Isolation of actinomycetes from soil sample
10. Morphological observation of microalgae in microscope
11. Micrometry – Measurement of bacteria.
12. Growth curve – Turbidity method
13. Biochemical tests: Carbohydrates and Proteins: quantitative estimation of glucose and glycogen from bacterial and Yeast cell, fermentation-acid-gas production; IMVIC test: hydrolysis of starch; Casein; Catalase test, oxidase, urease test, Nitrate reduction-Triple Sugar Iron test.
14. Principles of colorimetry: vertification of Beer's law, estimation of a selected protein, carbohydrate, DNA
15. pH, pK, Henderson-Hasselbach equation, preparation of buffers.
16. Separation of amino acids by paper chromatography.
17. Thin layer chromatography.

Reference

1. Jayaraman, J. (1981). Laboratory Manual in Biochemistry. New Delhi: New Age International (Pvt.) Ltd. Publishers.

2. Gunasekaran, P. (1995). Laboratory Manual in Microbiology. New Delhi: New Age International (P) Ltd. Publishers.

3. Reddy, C. A., Beveridge, T. J., Breznak, J. A., Marzluf, G. A., Schmidt, T. M., & Snyder L. R. (2007). Methods for General and Molecular Microbiology (3rd ed). Washington: American Society for Microbiology.

4. Cappuccino, J.H. and Sherman, N. (2014). Microbiology – A Lab Manual (10th ed). Singapore: The Benjamin Publishing Company.

COURSE OUTCOME

Upon completion of the course, the student will

- **CO1.** Learn the basic instruments used in microbiology
- **CO2.** identify the biochemical and physiological action of microorganisms
- **CO3.** Discuss the different types of staining techniques, practically.
- **CO4.** Demonstrate the isolation of microorganisms
- **CO5.** Explain the measurement of bacterial growth curve
- **CO6.** Appraise the physioco chemical properties

Cognetive Level

MGT 04: LAB IN GENERAL MICROBIOLOGY AND MICROBIAL BIOCHEMISTRY			
Class	I M.Sc, MGT	Semester	I
Cognitive Level	K-1	Knowledge	20
	K-2	Understand	20
	K-3	Apply	20
	K-4	Analyze	20
	K-5	Evaluate	20

Mapping

MGT 04: LAB IN GENERAL MICROBIOLOGY AND MICROBIAL BIOCHEMISTRY															
CO/PO	**PO**					**PSO**									
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
CO1	**2**	**2**	**1**	**2**	**2**	**1**	**1**	**2**	**3**	**1**	**3**	**1**	**2**	**2**	**3**
CO2	**2**	**2**	**1**	**2**	**2**	**1**	**1**	**2**	**1**	**3**	**2**	**1**	**2**	**1**	**3**

CO3	**1**	**2**	**3**	**3**	**3**	**3**	**2**	**3**	**2**	**3**	**2**	**2**	**3**	**2**	**2**
CO4	**3**	**2**	**3**	**2**	**3**	**3**	**3**	**2**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
CO5	**3**	**2**	**1**	**3**	**3**	**2**	**1**	**3**	**3**	**2**	**3**	**2**	**3**	**2**	**2**
CO6	**2**	**2**	**3**	**2**	**3**	**2**	**1**	**2**	**2**	**3**	**2**	**2**	**3**	**2**	**2**

3 - Strongly Correlated; 2 - Moderately Correlated; 1 - Weakly Correlated

Course Code: MGT 05 Lab in Molecular Biology **Credits - 4**
Hours - 15

Course objective:

- To isolate, characterize and quantify nucleic acids for various applications
- To practice and familiarize the isolation and quantification of bacterial DNA
- To perform the phage isolation and titrations

1. **Isolation and quantification of DNA and RNA**
2. Isolation of plasmid DNA from bacteria
3. Restriction digestion of plasmid
4. Determination of molecular weight of DNA
5. Cloning of fragment in plasmid
6. Preparation of competent E.coli cells
7. Transformation of plasmid DNA to the E.coli cells
8. Screening for transformants - Blue white selection
9. PCR amplification of DNA fragment**.**
10. Screening for recombinant proteins by SDS – PAGE
11. 12.Isolation of auxotrophic mutants
12. 13.Isolation of antibiotic resistant bacteria.

Reference

1. Malov, S.R. (1990). Experimental Techniques in Bacterial Genetics. Boston: Jones and Bartlett Publishers.
2. Miller, J.H. (1992). A Short Course in Bacterial Genetics: A Lab Manual &Hand Book for *E. coli* and related Bacteria. Cold Spring Harbour: Cold spring Harbor Lab press.
3. Ausubel, F.M., Roger, B., Robert E. Kingston, David A. Moore, Seidman J.G., John A. Smith. And Kelvin, S. (1992). Short Protocols in Molecular Biology (3rd ed). New York: Jolm Wiley &Sons Inc.
4. Sambrook, I., Fritsch, E.F. and Maniatis, T. (2001). Molecular Cloning 1, 2, 3 - A Laboratory Manual (3rd ed). USA: Cold Spring Laboratory Press.

LEARNING OUTCOME:

After successful completion of the lab work, the students will be able to

- CO1. Learn the basic handling molecular methods such as DNA and plasmid isolation
- CO2. Demonstrate and interpret the transduction and transpositions
- CO3. Perform and handle the molecular biological methods such as mutant isolation and auxotroph isolation

Cognetive Level

MGT 05: LAB IN MOLECULAR BIOLOGY			
Class	I M.Sc, MGT	Semester	I
Cognitive Level	K-2	Understand	20
	K-3	Apply	30
	K-4	Analyze	30
	K-5	Evaluate	20

Mapping

MGT 05: LAB IN MOLECULAR BIOLOGY															
CO/PO	**PO**					**PSO**									
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
CO1	**3**	**3**	**3**	**2**	**3**	**3**	**1**	**3**	**2**	**3**	**2**	**2**	**3**	**2**	**3**
CO2	**3**	**2**	**3**	**3**	**3**	**3**	**1**	**2**	**2**	**3**	**3**	**2**	**2**	**3**	**3**
CO3	**3**	**3**	**3**	**2**	**3**	**3**	**2**	**2**	**1**	**3**	**3**	**2**	**2**	**3**	**2**

- **3 - Strongly Correlated; 2 - Moderately Correlated; 1 - Weakly Correlated**

SEMESTER – II

Course Code: MGT06 BIORESOURCE TECHNOLOGY **Credits - 4**
Hours - 3

Scope

By the end of the course, the students will be able to know about the nature and current status of the bio-resources.The students will clearly get in-depth information about utilization of natural resources on the production of microbial products like enzymes, organic acids, antibiotic, vitamins, alcoholic beverages, steroid and non-steroid components. The course will provide in-depth theoretical knowledge on exploitation of natural resources. The course will also provide meticulous ideas on different types of fermentors and their functions.

Course Objectives:

- The aim of Bioresource Technology course is to know current bio-resources and their exploitations on the production of microbial products.
- The content of the precise course include nature of the bio-resources, industrially important microorganisms, up and down stream process.
- Fermentors functions, primary and secondary metabolites and production of recombinant products. It also covers production of steroids, sterols and non-steroid compounds through microbial transformations.

Unit – I Introduction to Bioresource

Introduction - Biomass, Biological wastes from domestic, agriculture and industries. Biological waste treatment, Bioenergy – Biofuels-Production of Biofuels, Acetone-butanol production, Biotransformations and bioresource systems analysis. Bioproducts: Biocatalysis and fermentations.

Unit – II Bioprocess Technology

Fermentation process - The range of fermentation process -Chronological development – Component parts of a fermentation process - Fermentation economics. Industrially important microorganisms - Isolation, preservation and improvement of strains -Handling, media for industrial fermentation -Formulation and sterilization, Development of inoculum for various upstream process.

Unit – III Fermentor types and design

Parts of a fermentor, body construction, heat production - gas liquid exchange - mass transfer - heat transfer - oxygen transfer - stirring and mixing. Scale up and scale down fermentation process. Control of temperature, pH, form pressure Sterilization of bioreactors and nutrients. Computer application in fermentation technology. Fermentation types –Submerged, solid state, batch and continuous fermentation.

Unit – IV Downstream processing

Recovery of intracellular and extra cellular products - Biomass separation by centrifugation, filtration, chemical and Electro flocculation. Cell disintegration - physical, chemical and enzymatic methods. Extraction - solvent, two phase, liquid extraction, whole broth, aqueous multiphase extraction. Purification by different methods, Concentration by precipitation, ultrafiltration, reverse osmosis. Drying and crystallization.

Unit – V Microbial Products

Organic acids - Amino acids, Antibiotics, Enzymes, Vitamins, Alcoholic beverages - wine and beer, Fermented foods - bread, cheese and soy sauce. Recombinant Products - insulin, interferon and growth hormone, Fermentation products from natural wastes - molasses, starch wastes and cellulosic wastes. Microbial transformations - steroids and sterols. Non-steroid compounds – Antibiotics.

References

1. Presscott and Dunn, S. (1940) Industrial Microbiology. New York, London.
2. Demain, A.L. and Soloman INA (1986) Mammal of Industrial Microbiology and Biotechnology, American society for Microbiology, Washington DC.
3. Crueger and Crueger, A. (1989) Biotechnology: A text book of Industrial Microbiology, 2nd edition, Sinavos association, InoSundeland.
4. Chand and Subhash (2001) Fermentation Biotechnology: Industrial Perspective, New Delhi : All India Biotech Association, Delhi.
5. Kumar, Sachin, Sani, and Rajesh K (eds) (2018) Biorefining of Biomass to Biofuels, Springer Publisher, ISBN: 978-3-319-67678-4. 2. MejdiJeguirim and Lionel Limousy (Eds.) (2018) Biomass Chars: Elaboration, Characterization and Applications, MDPI Books Publisher, ISBN: 978-3-03842-690-5. 3. Stanbury, P.F., Whittaker, A. and Hall, S.J. (1995) Principles of fermentation technology, 2nd edition, Pergamon press.

COURSE OUTCOME:

1. **CO1.** Understand the students will be able to know about the nature and current status of the bio-resources.

2. **CO2.** Describe the clearly get in-depth information about utilization of natural resources on the production of microbial products like enzymes, organic acids, antibiotic, vitamins, alcoholic beverages, steroid and non-steroid components.

3. **CO3.** The course will provide in-depth theoretical knowledge on exploitation of natural resources.

4. **CO4.** The course will also provide meticulous ideas on different types of fermentors and their functions.

5. **CO5.** The course contents will give several opportunities for the students to develop bio-entrepreneur for the production of microbial products by utilizing natural wastes.

Cognetive Level

MGT06: BIORESOURCE TECHNOLOGY			
Class	I M.Sc, MGT	Semester	II
Cognitive Level	K-1	Knowledge	20
	K-2	Understand	20
	K-3	Apply	20
	K-4	Analyze	20
	K-5	Evaluate	20

Mapping

MGT06: BIORESOURCE TECHNOLOGY															
CO/PO	**PO**					**PSO**									
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
CO1	**1**	**3**	**1**	**3**	**3**	**2**	**1**	**2**	**2**	**2**	**3**	**1**	**2**	**2**	**2**
CO2	**2**	**1**	**1**	**3**	**3**	**2**	**1**	**3**	**2**	**2**	**3**	**1**	**2**	**2**	**2**
CO3	**1**	**1**	**2**	**2**	**2**	**2**	**1**	**2**	**2**	**2**	**3**	**1**	**1**	**1**	**2**
CO4	**2**	**2**	**3**	**3**	**3**	**2**	**1**	**3**	**2**	**2**	**3**	**1**	**1**	**1**	**3**
CO5	**3**	**2**	**1**	**3**	**3**	**2**	**1**	**3**	**3**	**2**	**3**	**2**	**3**	**2**	**2**

3 - Strongly Correlated; 2 - Moderately Correlated; 1 - Weakly Correlated

Course Code: MGT07 FUNDAMENTALS OF IMMUNOLOGY **Credits - 3**
Hours - 3

Scope
This paper provides knowledge in principles and methods in Immunology.

Course Objectives:
- To provide knowledge on human immunity system
- To understand the mechanism of antigen antibody reaction
- Students will be exposed to all the concepts of cellular immunology, autoimmune disease, allergy, etc.

Unit I: Immune System and Immunity

History of Immunology; structures, composition and functions of cells and organs involved in immune system; host parasite relationships; microbial infections; virulence and host resistance; immune responses - innate Immunity, acquired Immunity; immunohaematology - blood groups, blood transfusion and Rh incompatibilities.

Unit II: Antigens and Antibodies

Antigens - structure and properties - types - lso and allo - haptens, adjuvants -antigen specificity. vaccines and toxoids. Immunoglobulins - structure - heterogeneity - types and subtypes properties (physico Chemical and biological); Theories of antibody production. Complement - Structure - components - properties and functions of complement components; complement pathways and biological consequences of complement activation.

Unit III: Antigen-antibody Reactions

Invitro Methods - agglutination, precipitation, complement fixation, immunofluorescence, ELISA, Radio lmmunoassays; In vivo Methods: skin tests and immune complex tissue demonstrations. applications of these methods in diagnosis of microbial diseases.

Unit IV: Major Histocompatibility Complex and Tumor immunology

Structure and functions of MHC and the HLA system. Gene regulation and Ir- genes; HLA and tissue transplantation - Tissue typing methods for organ and tissue transplantations in humans; graft versus host reaction and rejection; autoimmunity - theories, mechanism and diseases with their diagnosis; tumor immunology - tumor specific antigens, Immune response to tumors, immunodiagnosis of tumors - detection of tumor markers - alphafoetal proteins, carcinoembryonic antigen etc.,

Unit V: Hypersentivity Reactions

Antibody - mediated - Type I. Anaphylaxis; Type II. Antibody dependent cell cytotoxicity; Type Ill. Immune complex mediated reactions; Type IV. Cell mediated hypersensitivity reactions. The

respective diseases, immunological methods of their diagnosis. Lymphokines and cytokines - their assay methods.

References

1. Kuby, J (1994) Immunology II Edition. WH. Freeman and Company, New York.
2. Roitt, I.M. (1998) Essentials of immunology. ELBS, Blackwell Scientitic Publishers, London.
3. Benjamini, E., Coico, R., and Sunshine, G., (2000). Immunology a short course. IV edn. Wiley-Lisst, New York.
4. Goldsby, R. A., Kindt, T.I., and Osborne, B.A., (2007). Kuby Immunology IV edn. WH Freeman &Co, New York.

COURSE OUTCOME:

On completion of the course, the student is expected to understand:

- **CO1.** Describe the basic mechanism of innate and acquired immunity humoral and cell mediate immunity
- **CO2.** Describe the cellular and molecular mechanism of lymphocyte production and activation
- **CO3.** Understand the antigen and antibody response and immunotechniques can be used in disease diagnostics.
- **CO4.** Demonstrate the cellular process involved in inflammation and immunity, hypersensitivity reactions.

Cognetive Level

MGT07: FUNDAMENTALS OF IMMUNOLOGY			
Class	I M.Sc, MGT	Semester	II
Cognitive Level	K-1	Knowledge	30
	K-2	Understand	20
	K-3	Apply	30
	K-4	Analyze	20

Mapping

MGT07: FUNDAMENTALS OF IMMUNOLOGY															
CO/PO	**PO**					**PSO**									
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
CO1	**3**	**3**	**1**	**1**	**3**	**2**	**1**	**2**	**2**	**2**	**3**	**1**	**2**	**2**	**2**
CO2	**2**	**1**	**3**	**1**	**3**	**2**	**1**	**3**	**2**	**2**	**2**	**1**	**3**	**2**	**2**
CO3	**2**	**1**	**2**	**1**	**2**	**2**	**1**	**2**	**2**	**2**	**3**	**1**	**2**	**1**	**1**
CO4	**2**	**2**	**3**	**3**	**3**	**2**	**1**	**3**	**2**	**2**	**3**	**1**	**1**	**1**	**3**
CO5	**3**	**2**	**1**	**3**	**3**	**2**	**1**	**3**	**3**	**2**	**3**	**2**	**3**	**2**	**2**

3 - Strongly Correlated; 2 - Moderately Correlated; 1 - Weakly Correlated

Course Code: MGT08 MEDICAL MYCOLOGY AND PARASITOLOGY **Credits - 4**
Hours - 3

Course Objectives:

- The course contents are designed to understand the basic information about the fungi and their associated diseases based on the signs and symptoms.
- Virulence factors of bacterial and protozoan pathogens.
- The mechanism of pathogenesis, laboratory diagnosis and treatment of bacterial and protozoan infections.

UNIT – I Medical Mycology

Introduction-Historical Perspectives and Miles stones in Mycology, Fungal Taxonomy- Binomial nomenclature, fungal repository and databases, Classification of medically important fungi, Immunity to fungal diseases- cellular and humoral Immunity. Collection and Transport of fungal specimens.

UNIT – II Antifungal Therapy

Historical Perspectives and Current scenario, Classification of Antifungals-Polyene, Synthetic and Miscellaneous antifungals, Antifungal Susceptibility testing-CLSI guidelines, Diagnosis of Fungal infections- Conventional and non-conventional methods, Current techniques in fungal diagnosis.

UNIT – III Mycosis

Superficial mycosis - Tinea, Piedra, Cutaneous mycosis - Dermatophytosis. Subcutaneous mycosis - Sporotrichosis, Mycetoma, Systemic mycosis- Blastomycosis and Histoplasmosis. Opportunistic mycosis - Candidiasis, Aspergillosis and Mucoromycosis,Miscelleneous mycosis-oculomycosis, Emerging fungal diaseases.

UNIT – IV Parasitology: Amoeba and Flagellates

Parasitology- introduction and classification. Sarco Mastigophora – Sarcodina - Intestinal amoeba – *Entamaeba histolytica*. Free living amoebae – *Naegleria fowleri, Acanthamoeba* spp. Mastigophora – Intestinal and genital flagellates – Giardia, Trichomonas. Blood and tissue flagellates – *Leishmania donovani, Trypanosoma cruzi* and *T. brucei* complex. Apicomplexa – Haemosporina – Malarial Plasmodium, Ciliates – *Balantidium coli*.

UNIT – V Helminthology

Helminthology – Cestodes – *Taenia solium, Taenia saginata*. Trematodes – *Schistosoma haematobium, Faciola hepatica, Faciola buski*. Nematodes – *Trichuris trichura,* Intestinal nematode-*Enterobius vermicularis, Ascaris lumbricoides*. Filarial nematode - *Wucheriria bancrofti*. Extra intestinal nematodes –*Trichinella spiralis*.

References

1. Errol Reiss, Jean Shadomy, H. and Marshall Lyon, G. (2011) Fundamental Medical Mycology. 1stEdition, Wiley Blackwell.

2. Karyakarte, R.P. and Damle, A.S. (2012) Medical Parasitology, 3rdEdition,Books and Allied (P) Ltd., Kolkatta.

3. Sougata,G (2013)Paniker's Textbook of Medical Parasitology, 7th Edition. JAYPEE brothers, Medical Publishers (P) Ltd, New Delhi.
4. Alexpoulos, C.J., Mims, C.W. and Blackwell, M. (2014) Introductory Mycology.4th Edition, John Wiley & sons, New Delhi.

COURSE OUTCOME:

At the end of the course, learners will be able to:

- **CO1.** To understand the basic aspects of fungi with its taxonomy, various fungal databases, know about fungal immunity and the methods used in the specimen collections.

- **CO2.** Know about the different classes of antifungals, their mode of action, methods followed in diagnosis of fungal infections and its treatment.

- **CO3.** Know about the different types of fungal infections, properties of the fungi causing these infections, the diagnostics methods and the treatment of these infections.

- **CO4.** Can interpret the results of morphological, biochemical, cultural characteristics of medically important protozoans from the given samples to help in their identification.

Cognetive Level

MGT08: MEDICAL MYCOLOGY AND PARASITOLOGY			
Class	I M.Sc, MGT	Semester	II
Cognitive Level	K-1	Remember	30
	K-2	Understand	30
	K-3	Apply	20
	K-4	Analyze	20

Mapping

MGT08: MEDICAL MYCOLOGY AND PARASITOLOGY															
CO/PO	**PO**					**PSO**									
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
CO1	**2**	**1**	**3**	**3**	**3**	**1**	**1**	**2**	**2**	**2**	**3**	**1**	**2**	**2**	**2**
CO2	**1**	**3**	**2**	**1**	**3**	**2**	**1**	**3**	**2**	**2**	**3**	**1**	**2**	**2**	**2**
CO3	**1**	**2**	**1**	**2**	**2**	**2**	**1**	**2**	**2**	**2**	**3**	**1**	**1**	**1**	**2**

CO4	**2**	**3**	**3**	**2**	**3**	**2**	**1**	**3**	**2**	**2**	**3**	**1**	**1**	**1**	**3**

3 - Strongly Correlated; 2 - Moderately Correlated; 1 - Weakly Correlated

Course Code: MGT09 LAB IN INDUSTRIAL MICROBIOLOGY Credits - 4
Hours - 9

Course objective:

- The aim of this course is to know various methods adopting to isolate, screen the industrially important microorganism and apply for the production of microbial products like enzyme, antibiotic, alcohol and biosurfactants.
- To perform purification and characterization of the products by appropriate methods.

1. Isolation and screening of antibiotic producing microorganisms from soil.
2. Screening of enzyme producing organisms (e.g. Amylase and Cellulase) by submerged fermentation and solid state fermentation.
3. Assay of extracellular enzymes produced by bacteria: a) Amylase, b) Protease and c) Lipase.
4. Purification of enzymes by filtration method/chemical method by ammonium sulphate.
5. Production of wine.
6. Production of alcohol from agricultural wastes (sugarcane molasses and beetroot).
7. Biofuel Production- Alcohol & Hydrogen
8. Characterization of alcohol: Nutritive value, Colour, Haze, Viscosity, foam Characteristics, gurting flavor
9. Microbial production of citric acid by using *Aspergillus*.
10. Production of extracellular metabolites from actinomycetes
11. Production and extraction of biosurfactant.
12. Quantification and characterization of biosurfactant.
13. Synthesis and separation of bioactive compounds - TLC or Column Chromatography.
14. Immobilization of cells and enzymes.
15. Antibiotic sensitivity test - Kirby Bauer's method and
16. MIC determination by filter paper assay and broth dilution assay.

References:

1. Arnold L. Demain, Julian E. Davies, Ronald M. Atlas, Gerald Cohen, Charles L. Hershberger, Wei-Shou Hu, David H. Sherman, Richard C. Willson and David Wu, J.H. (1999) Manual of Industrial Microbiology and Biotechnology, 2nd Edition.
2. Mathur, N. and Singh, A. (2007) Industrial Microbiology: A Laboratory Manual, Pointer publishers.
3. Kulandaivel and Janarthanan, S. (2012) Practical Manual on Fermentation Technology, ISBN: 9789381141809.
4. Basanta Kumar Rai and Dil Kumar Subba (2016) Basic Practical Manual on Industrial Microbiology, Dharan Multiple Campus, Nepal.

COURSE OUTCOME:

- **CO1.** The students will able to know about the techniques to isolate and screen the significant microorganisms capable to produce products.
- **CO2.** Provide meticulous ideas for the production of ethanol from natural and industrial wastes.

- **CO3.** Provide in-depth knowledge and ideas for the production of biosurfactant and its characterization.
- **CO4.** The course contents will give several opportunities for the students to develop bio-entrepreneur for the production of microbial products by utilizing natural wastes.

Cognetive Level

MGT09: LAB IN INDUSTRIAL MICROBIOLOGY			
Class	I M.Sc, MGT	Semester	II
Cognitive Level	K-2	Understand	20
	K-3	Apply	30
	K-4	Analyze	30
	K-5	Evaluate	20

Mapping

MGT09: LAB IN INDUSTRIAL MICROBIOLOGY															
CO/PO	**PO**					**PSO**									
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
CO1	**3**	**2**	**3**	**3**	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**3**	**2**	**3**
CO2	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**1**	**3**	**2**	**3**
CO3	**2**	**3**	**3**	**2**	**3**	**3**	**2**	**2**	**2**	**2**	**1**	**2**	**3**	**2**	**3**
CO4	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**3**

3 - Strongly Correlated; 2 - Moderately Correlated; 1 - Weakly Correlated

Course Code: MGT10 **Credits - 4**
Hours - 9

Lab in MEDICAL MICROBIOLOGYAND IMMUNOLOGY

Course Objectives:

- The course contents are designed to gain adequate hand on knowledge and acquire adequate skill to identify fungi and parasites from clinical samples, cultivate fungi and parasites based on morphology, cultural and biochemical characteristics.
- The objective of this course is to train the student in diagnostic and therapeutic tolls and methods.
- The course will also provide hands-on training in basic immunological techniques. The student will be trained to perform various immunological assays.

1. Cultivation and Identification of fungi by Lactophenol cotton blue (LPCB) mount of Mucor, Rhizopus, Aspergillus, Penicillium, Fusarium, Curvularia, Bipolaris&Trichophyton).
2. Identification of Non sporulating fungi- Slide culture method, Cornmeal/Tapwater agar.
3. Identification of Candida species- Germ tube method,Sugar assimilation/ fermentation test, species differentiation on Hichrome agar.
4. Examination of parasites in clinical specimens- Floatation and sedimentation techniques of stool examination.
5. Blood smear examination for malarial parasites.
6. Enumeration of WBC & RBC
7. Haemagglutination test
8. Ouchterlony double immunodiffusion test
9. Separation of serum and plasma from human peripheral blood
10. Isolation of human PBMC-Boyums Method
11. Serodiagnosis of HIV, HBV, HCV
12. Bacterial agglutination test: Widal
13. Serodiagnosis of C-Reactive protein, Rheumatoid factor, Antistreptolysin O titer

Reference:

1. Carpenter D.L.(1975). Immunology and Serology (3rd ed). London: W.B. Saunders Company.
2. Rastogi S.C. (1996). Immunodiagnostics Principles and Practice. New Delhi: New Age International (P) Ltd.
3. James, G.C. and Sharman, N. (1997) Microbiology: A laboratory Manual, 4thEdition, The Benjamin/ Cummings Publishing Company, International USA.
4. Finegold, S.M. (2000) Diagnostic Microbiology, 10th Edition, C.V. Mos by Company, St. Louis
5. Verma, A.S., Surajit, D and Anchal, S. (2014). Laboratory Manual for Biotechnology. New Delhi: S. Chand and Company Ltd.

COURSE OUTCOME:

On completion of the course, the student is expected to understand

CO1. Gain knowledge on identification of fungi and parasites from clinical specimens.
CO2. Gain knowledge on examination of parasites from clinical specimens..
CO3. Various immunological methods including immuno & antigen typing.
CO4. Demonstrate knowledge and understanding of immunology and the means of applying in the diagnostic and therapeutic techniques and research.
CO5. Importance of serum-based assays and diagnosis
CO6. Correlate the molecular and immunological assay results with associated disease

Cognetive Level

MGT10: Lab in MEDICAL MICROBIOLOGYAND IMMUNOLOGY			
Class	I M.Sc, MGT	Semester	II
Cognitive Level	K-1	Knowledge	20
	K-3	Apply	20
	K-4	Analyze	20
	K-5	Evaluate	20
	K-6	Create	20

Mapping

MGT10: Lab in MEDICAL MICROBIOLOGYAND IMMUNOLOGY															
CO/PO	**PO**					**PSO**									
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
CO1	**2**	**2**	**3**	**3**	**3**	**3**	**2**	**1**	**1**	**1**	**1**	**3**	**1**	**1**	**3**
CO2	**1**	**1**	**1**	**2**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**3**	**1**	**2**	**1**
CO3	**1**	**1**	**3**	**3**	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**3**	**3**	**3**	**3**
CO4	**1**	**1**	**3**	**3**	**3**	**2**	**2**	**1**	**1**	**1**	**1**	**3**	**2**	**3**	**2**
CO5	**1**	**1**	**3**	**3**	**3**	**2**	**2**	**2**	**1**	**1**	**1**	**3**	**3**	**3**	**3**
CO6	**2**	**2**	**3**	**3**	**3**	**2**	**2**	**3**	**1**	**1**	**1**	**3**	**2**	**2**	**3**

3 - Strongly Correlated; 2 - Moderately Correlated; 1 - Weakly Correlated

SEMESTER-III

Course Code: MGT11 ENVIRONMENTAL MICROBIOLOGY **Credits - 4**
Hours - 3

Course Objectives:

- This course aims to communicate the students with basic principles of microbiology and their applications in environment.
- It also prepares the student to address pressing environmental challenges by developing a fundamental understanding of the microbial communities and processes in natural and built environments.
- It lays and builds upon the foundation of basic microbiology, microbial energetics and diversity to applying the tools provided by microbiology ranging from traditional to state of art for addressing relevant environmental concerns.
- It provides an in depth exploration of the diverse role of microbes and microbial communities in each sector.

UNIT – I Aerobiology and Ecology

Aerobiology: Droplet nuclei, aerosal, assessment of air quality, - solid - liquid - impingment methods. Brief account of air borne transmission of microbes – viruses - bacteria and fungi, their diseases and preventive measures. Ecology: Interaction between abiotic and biotic factors in an ecosystem, ecological niche, limiting factor, concept of community, fluctuation and succession. Ecological pyramid, energy flow, food chain, food webs and their dynamism, stability and complexity of ecosystem. Microbial communities: Microenvironment and niche, communities in soil, water, air.

UNIT – II: Soil Microbiology

Soil Microbiology: Classification of soils - physical and chemical characteristics, microflora of various soil types (bacteria and nematodes in relevance to soil types; rhizosphere -phyllosphere - brief account of microbial interactions symbiosis - mutualism - commensalism - competition - amensalism - synergism - parasitism - predation; biogeochemical cycles and the organisms, - carbon, nitrogen - phosphorus and sulphur, biofertilizers - biological nitrogen fixation - nitrogenase enzyme - nif genes; symbiotic nitrogen fixation - (Rhizobium, Frankia) - non symbiotic microbes - Azotobacter - Azospirilium - (vesicular arbuscular mycorrhizae - VAM) - ecto, endo, ectendomycorrhizae - rumen microbiology.

UNIT – III Aquatic Microbiology

Aquatic Microbiology: The aquatic environment - major environmental conditions influencing micro flora. Distribution of microorganisms in the aquatic environments - freshwater environment, estuaries and marine environment. Microorganisms in freshwater, marine and sewage environments. Microbiology of drinking water. Purification of water for human consumption.

UNIT – IV: Roles of microbes in environment and Microbial Biofilms

Positive and negative roles of microbes in environment: biodegradation of recalcitrant compounds – lignin- pesticides; bioaccumulation of metals and detoxification - biopesticides; biodeterioration - of paper - leather, wood, textiles - metal corrosion -mode of deterioration - organisms involved -its disadvantages - mode of prevention. GMO and their impact. Microbial Biofilms : Physiology, Morphology; Biochemistry of microbial biofilms formed in natural environment - Lab methods used to obtain biofilms – physiology - growth - spatial arrangement – Beneficial & harmful role of biofilms. Extreme environments: Thermophiles, psychrophiles, barophiles, halophiles, osmophiles, alkaliphiles, acidophiles and oligotrophs.

UNIT – V: Waste treatment:

Wastes - types - solid and liquid wastes Characterization - solid - liquid; treatments - physical, chemical, biological - aerobic - anaerobic - primary - secondary - tertiary; solid waste treatment - saccharification - gasification - composting, Utilization of solid wastes - food (SCP, mushroom, yeast): fuel (ethanol, methane) fertilizer (composting), liquid waste treatment - trickling - activated sludge -oxidation pond - oxidation ditch. Subterranean microbes and bioremediation

References:

1. Atlas, R.M. and Bartha, *R*. 1992. Microbial Ecology – Fundamentals and applications [Fourth Edition], Red Wood City C.A Benjamin/ Cummings. Menlo Park, California, USA.
2. Ec Eldowney, S. Hardman, D.J. and Waite, S. 1993. Pollution: Ecology and biotreatment — Longman Scientific Technical.
3. Coyne, M.S 1999. Soil Microbiology. An explanatory approach. Delmar publishers, USA.
4. Raina *M Maier, Ian L Pepper and Charles P Gerba* 2000. Environmental Microbiology, Academic press. USA.
5. Microbial Fuel Cell, Bruce E. Logan, John Wiley & Sons, ISBN: 0470239484

COURSE OUTCOME:

Upon successful completion of the course, the student:

- **CO1.** The students will be able to know about the significance of the microbes in environment
- **CO2.** Provide in-depth information about the harmful effects and beneficial role of microbes in each sector.
- **CO3.** Provides in depth knowledge on water and waste water treatment to tackle the current environmental problems.

- **CO4.** Provide meticulous thoughts on the task of microbes in waste water treatment and solid waste management.

Cognetive Level

MGT11: ENVIRONMENTAL MICROBIOLOGY			
Class	II M.Sc, MGT	Semester	III
Cognitive Level	K-2	Understand	30
	K-3	Apply	20
	K-4	Analyze	30
	K-5	Evaluate	20

Mapping

MGT11: ENVIRONMENTAL MICROBIOLOGY															
CO/PO	**PO**					**PSO**									
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
CO1	**1**	**2**	**3**	**3**	**3**	**2**	**1**	**2**	**2**	**2**	**3**	**1**	**2**	**2**	**2**
CO2	**2**	**1**	**2**	**3**	**3**	**2**	**1**	**3**	**2**	**2**	**3**	**1**	**2**	**2**	**2**
CO3	**1**	**1**	**2**	**2**	**2**	**2**	**1**	**2**	**2**	**2**	**3**	**1**	**1**	**1**	**2**
CO4	**2**	**2**	**3**	**3**	**3**	**2**	**1**	**3**	**2**	**2**	**3**	**1**	**1**	**1**	**3**

3 - Strongly Correlated; 2 - Moderately Correlated; 1 - Weakly Correlated

Course Code: MGT12 **FOOD MICROBIOLOGY** **Credits - 4**
Hours - 3

Course objective:

- The course will enable students to understand the taxonomical classification, phenotypic and biochemical identification of food associated molds, yeasts, yeast-like fungi and bacteria.
- The course will teach the strategies to develop fermented and non-fermented milk products, plant-based products, fish products, meat products bioactive compounds and malt beverages, wines, distilled liquors and vinegar.
- The role of microbes in food spoilage, preservation and various foodborne diseases will be discussed.

UNIT- I: Food as substrate for microorganisms

Micro organisms important in food microbiology - Sources of contamination of microorganisms in foods, Factors influencing microbial growth in food - Extrinsic and intrinsic factors Food borne diseases. Spoilage of fruits, vegetables, meat, poultry, fish and seafoods. Methods of food preservation: Applications of food microbiology: Beneficial uses of microorganisms in food, Intestinal beneficial bacteria, Probiotics, Prebiotics – Definition, functional foods, types, importance and economic values, Recombinant foods, Biosensors in food industry.

UNIT-II: Dairy products

Microflora of milk and milk products, Fermented milk and milk products: Sauerkraut, Buttermilk, Cream, Yogurt, Cheese, Kafir and kumiss. Microbes involved in fermentation: Starter lactic acid cultures. Spoilage of milk and milk products, Milk borne diseases. Preservation of milk and milk products. Sanitation of dairy processing plant, food control agencies and their regulations.

UNIT – III: Food-borne infections and spoilage

Bacterial and nonbacterial- with examples of infective and toxic types - Brucella, Bacillus, Clostridium, Escherichia, Salmonella, Shigella, Staphyloco- ccus, Vibrio, Yersinia, Nematodes, protozoa, algae, fungi and viruses. Foodborne outbreaks- laboratory testing procedures; Prevention Measures-Food sanitation in manufacture and retail trade; Food control agencies and its regulations, Plant sanitation-Employee's Health standards- waste treatment-disposal- quality control. Cereals, sugar products, vegetables, fruits, meat and meat products, Milk and Milk products- Fish and sea foods-poultry- spoilage of Canned foods. Detection of spoilage and characterisation.

UNIT – IV: Food fermentations

Bread, cheese, vinegar,fermented vegetables, fermented dairy products; Experimental and Industrial production methods. Spoilage and defects of fermented dairy products- oriental Fermented foods, their quality standards and control.

UNIT –V: Food produced by Microbes

Fermented foods, microbial cells as food (single cell proteins) - mushroom cultivation. Bioconversions- Production of alcohol-Fermented beverages-beer and wine. Steroia conversion - Industrial Enzymes production-amylases, proteinases, cellulases; Aminoacid production - glutamic acid and lysine productions. GenelicaIIy modified foods.

References:

1. Frazier WC and Westhoff Dc (1988). Food Microbiology. Tata McGraw Hill Publishing Company Ltd, New Delhi.
2. James M Jay, Martin J Loessner, and David A Golden. (2005) Modern Food Microbiology, 7th Edition. CBS Publisher.
3. Pina M. Fratamico, Arun K. Bhunia, and James L. Smith. (2005). Food-borne Pathogens:Microbiology and Molecular Biology. 1st Edition, Caister Academic Press.
4. Adams, M.R. and M.G. Moss. (2007): Food Microbiology, 3rd Edition, Royal Society of Chemistry (RSC) Publishing.

Course outcome:

Upon successful completion of the course, the student:

- **CO1.** Will know about production and evaluation of the quality of starter cultures and fermented milk products and understands the use and production of probiotics, prebiotics, and nutraceuticals.
- **CO2.** Gathers information regarding microbes causing food intoxications and food-borne infections.
- **CO3.** Knows traditional food preservation techniques including drying, salting, pickling, refrigeration, freezing, oxidation, vacuum packaging, canning/bottling, smoking, sugaring, chemical preservation, and irradiation.
- **CO4.** Understands the relevance of microbial standards for food safety, quality assurance programs that revolutionize food safety.
- **CO5.** Identify ways to control microorganisms in foods and thus know the principles involving various methods of food preservation.

Cognetive Level

MGT12: FOOD MICROBIOLOGY			
Class	II M.Sc, MGT	Semester	III
Cognitive Level	k-2	Understand	20
	K-3	Apply	30
	K-4	Analyze	30
	K-5	Evaluate	20

Mapping

MGT12: FOOD MICROBIOLOGY															
CO/PO	**PO**					**PSO**									
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
CO1	**3**	**3**	**3**	**2**	**3**	**3**	**3**	**2**	**1**	**2**	**1**	**2**	**3**	**3**	**3**
CO2	**3**	**1**	**3**	**3**	**3**	**3**	**3**	**3**	**1**	**1**	**1**	**3**	**1**	**3**	**3**
CO3	**3**	**3**	**2**	**3**	**3**	**3**	**3**	**3**	**1**	**1**	**3**	**1**	**1**	**2**	**3**
CO4	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**3**	**2**	**2**	**2**	**3**
CO5	**3**	**3**	**3**	**2**	**3**	**2**	**3**	**3**	**3**	**3**	**1**	**3**	**3**	**3**	**3**

3 - Strongly Correlated; 2 - Moderately Correlated; 1 - Weakly Correlated

Course Code: MGT13 **rDNA TECHNOLOGY** **Credits - 3**
Hours - 3

Scope

This paper provides knowledge on principles and methods in genetic engineering, vectors in gene cloning, transformation in higher organisms, throws light on various molecular tools used for genetic manipulation.

Course objective:

- The objective of this course is to make the student familiar with the currently used techniques to manipulate/ analyze DNA, RNA and proteins.
- The student will be made familiar with the methods used to clone genes, make and screen libraries, and the various applications of the polymerase chain reaction. .
- The student will be made familiar with how recombinant DNA technology has been exploited in the study of biology as well as in the production of pharmaceutical products

Unit I : Basics in rDNA Technology: Core techniques and essential enzymes used in rDNA technology. Restriction digestion, ligation and transformation. Introduction, Scope and significance of recombinant DNA Technology – Principles and methods in genetic transformation - Bacterial Transformation - Transformation in *E. coli*, *Saccharomyces*, *Synechococcus* etc. Isolation and purification of Nucleic Acids (DNA, RNA), Agarose Gel Electrophoresis, Pulsed field electrophoresis - Two-dimensional gel electrophoresis - Hybridization –Southern, Western – Northern.

UNIT II: Gene Cloning Techniques: Cloning vectors - plasmids, phages and cosmids. Cloning strategies. Cloning and selection of individual genes, gene libraries: cDNA and genomic libraries. DNA Modification and enzymes - restriction endonucleases – Type I, II, III and other enzymes. Specialised cloning strategies. Expression vectors, Promoter probe vectors, vectors for library construction - artificial chromosomes. Cloning vectors and strategies - Plasmids, Bacteriophages, Phagemids, Cosmids – Artificial Chromosomes: BAC, YAC - Vectors for making RNA probes - Cloning in Prokaryotes - Gram negative and Gram positive bacteria - *E. coli* and fungi - Expression vectors - pBAD system - expression of foreign proteins in *E. coli* – plasmid copy number – relaxed plasmid - specialized vectors, T-tailed vector, cDNA library, identification of clones and screening techniques.

Unit III: Techniques in rDNA Technology: PCR methods and application. Isolation of specific nucleic acid sequence – primer designing – PCR amplification – specific, RT, Semi quantitative, Multiplex, Inverse etc - DNA sequencing methods, Methods for analysis of gene expression at RNA and protein level - Functional genomics: Nucleic acid microarrays and Real Time PCR. RNAi and Gene Silencing - Detection of post translation modification of proteins. Chromosome walking - DNA sequencing.

Unit IV: Gene transfer techniques- Gene transfer techniques in microbes - Direct and indirect methods - Electroporation, microprojectile system, - Gene gun, transfection with phage vectors etc. *Agrobacterium* based gene transfer in plants - Ti plasmid: structure and functions, Ti

plasmid-based vectors. Features of Ti and Ri plasmids and its use as vectors, binary vectors, viral vectors, 35S and other promoters, use of reporter genes and marker genes with introns. Strategies for marker free transformation. Transgene stability, Gene silencing, knock out and RNAi. DNA sequencing Methods; dideoxy and chemical method. Sequence assembly. Automated sequencing. Genome sequencing and physical mapping of genomes.

Unit V:Application of rDNA

Technology: r - DNA technology Herbicide resistance, phosphoinothricin, glyphosate, sufonyl urea, atrazine - Insect resistance - Bt Cotton and Brinjal, Bt genes, Non-Bt like protease inhibitors, alpha amylase inhibitor, virus resistance, coat protein mediated, nucleocapsid gene, disease resistance, chitinase, 1-3 beta glucanase, RIP, antifungal proteins, thionins, PR proteins, nematode resistance, Use of ACC synthase, polygalacturanase, ACC oxidase, bar and barnase systems, ADP glucose pyrophosphatase .

References

1. Nester, E. W., Anderson, D.G., Roberts, C.E., Pearsall and Nester, M. T. (2001). Microbiology: A human perspective. Third Edition McGraw Hill.
2. Madigan, M.T, and Martinko, .JM. (2006). Brock Biology of Micro-organisms 8th edition. Parker J. Prentice Hall International, Inc
3. Willey, J.M., Sherwood, L.M., and Woolverton, C.J. (2008). Prescott, Harley and Klein's Microbiology. 7th edition. McGraw Hill Higher Education.
4. Jacquelyn G Black (2008). Microbiology: Principles and Explorations, 7th edition. Prentice Hall.

Course outcome:

Upon successful completion of the course, the student:

- **CO1.** Understand the enzymes and vector which serves an indispensable tools in recombinant DNA technology.
- **CO2.** Understand the principle and the concept of cloning strategies and restriction mapping.
- **CO3.** Will be able to describe the various applications of PCR and know how to make and screen genomic and cDNA libraries.
- **CO4.** Understand the recombinant DNA technology and its applications.
- **CO5.** Apply the techniques of genetically engineered foods and crops and societal concerns .

Cognetive Level

MGT13: rDNA TECHNOLOGY			
Class	II M.Sc, MGT	Semester	III
	K-2	Understand	30
	K-3	Apply	30
	K-4	Analyze	20
	K-5	Evaluate	20

Mapping

MGT13: rDNA TECHNOLOGY															
CO/PO	**PO**					**PSO**									
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
CO1	**2**	**3**	**2**	**3**	**3**	**3**	**3**	**2**	**1**	**2**	**3**	**2**	**3**	**2**	**3**
CO2	**1**	**3**	**3**	**2**	**3**	**3**	**3**	**3**	**1**	**1**	**2**	**1**	**1**	**3**	**3**
CO3	**3**	**1**	**3**	**3**	**3**	**3**	**3**	**3**	**1**	**2**	**3**	**1**	**1**	**2**	**3**
CO4	**3**	**3**	**3**	**1**	**1**	**3**	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**3**
CO5	**3**	**3**	**2**	**1**	**3**	**3**	**3**	**2**	**3**	**3**	**2**	**2**	**3**	**3**	**3**

3 - Strongly Correlated; 2 - Moderately Correlated; 1 - Weakly Correlated

Course Code: MGT14 **Credits - 4**
Hours - 9

Lab in ENVIRONMENTAL AND FOOD MICROBIOLOGY

Course objective:

- To give hands-on experience on isolation and characterization of microbes from different food sources and different spoiled food sources.
- This paper is designed with the objective to impart hand-on experience and laboratory skills to students in the area of bioprocess.
- The practical structure is designed so that students are trained to set up different fermentation processes with special emphasis on the downstream processing of bio-molecules purification and characterization.

1. Isolation of acidophilic and alkaliphilic microorganisms.
2. Isolation of halotolerant microorganisms.
3. Determination of indoor air quality.
4. Microbial testing of drinking water by coliforms test.
5. Isolation of ferric iron-reducing bacteria, sulphate-reducing bacteria, nitrate reducing bacteria, phenol degrading bacteria.
6. Isolation of microalgae from fresh water.
7. Isolation of microalgae from marine water.
8. Determination of BOD of polluted water.
9. Reduction test for milk – Methylene blue reduction test.
10. Wine making from grape juice by fermentation.
11. Assessment of quality of vegetables, fruits, milk and milk products.
12. Production of curd and cheese.
13. Isolation of bacteria and fungi from spoiled vegetables and fruits.
14. Immobilization of cells

References:

1. SubbaRao, N.S. (1995). Soil Microorganisms and Plant Growth (3rd ed). New Delhi: Oxford & IBH Publishing Co. Pvt. Ltd.
2. Demain, A.L, and Davis, J.E. (1999). Manual of Industrial Microbiology and Biotechnology (2nd ed). Washington: American Society for Microbiology.
3. Collins and Lyne's Microbiological methods, (2001). New York: Arnold publishers.
4. Cappuccino, J.H. and Sherman, N. (2007). Microbiology – A Lab Manual (7th ed). Singapore: The Benjamin Publishing Company.

COURSE OUTCOME

Upon completion of the course, the student will

- **CO1.** To analyse the role of microorganism in various environment
- **CO2.** Will perform water quality analysis
- **CO3.** The course involves demonstration and on-hand training of various microbiological techniques like isolation of food poisoning bacteria
- **CO4.** Employability opportunity in dairy industry for learning the quality analysis of milk
- **CO5.** Microbial cell immobilization in different matrices

Cognetive Level

MGT14: LAB IN ENVIRONMENTAL AND FOOD MICROBIOLOGY			
Class	II M.Sc, MGT	Semester	III
Cognitive Level	K-2	Understand	20
	K-3	Apply	30
	K-4	Analyze	30
	K-5	Evaluate	20

Mapping

MGT14: LAB IN ENVIRONMENTAL AND FOOD MICROBIOLOGY															
CO/PO	**PO**					**PSO**									
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
CO1	**1**	**2**	**2**	**2**	**2**	**1**	**1**	**3**	**3**	**1**	**2**	**1**	**2**	**2**	**3**
CO2	**1**	**2**	**2**	**2**	**2**	**1**	**1**	**3**	**1**	**2**	**2**	**1**	**2**	**1**	**3**
CO3	**1**	**2**	**3**	**3**	**3**	**2**	**2**	**3**	**3**	**3**	**2**	**2**	**2**	**2**	**3**
CO4	**2**	**2**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
CO5	**2**	**2**	**3**	**3**	**3**	**2**	**1**	**3**	**3**	**2**	**2**	**2**	**3**	**2**	**2**

3 - Strongly Correlated; 2 - Moderately Correlated; 1 - Weakly Correlated

Course Code: MGT15 Lab in rDNA Technology **Credits - 4**

Hours - 6

Course objective:

- The objective of this course is to train the student in basic molecular biology and gene transformation techniques.
- The student will learn how to isolate, analyze, and amplify DNA. The student will learn mutagenesis studies.

1. Isolation of total DNA and plasmid DNA from Bacterial sources
2. Restriction digestion of Bacterial genomic DNA
3. PCR amplification of target gene
4. Preparation of probes for hybridization
5. Restriction mapping - Plasmids.
6. *Agrobacterium* mediated gene transformation
7. RNA preparation from bacteria
8. Screening of clones by hybridization
9. DNA cloning using plasmid vectors and in E.coli expression vectors.
10. Analysis of recombinant proteins using polyacrylamide gel electrophoresis.
11. Southern and Northern blotting
12. DNA sequencing. Sanger's method.

References:

1. Berger, S.L. and Kimmel, R. (1987). Guide to Molecular Cloning Techniques. New York: Academic Press, Inc.
2. Brown, T.A. (1998). Molecular Biology Lab Fax 11 Gene Analysis. London: Academic Press.
3. Sambrook, I., Fritsch, E.F. and Maniatis, T. (2001). Molecular Cloning 1, 2, 3 - A Laboratory Manual (3rd ed). USA: Cold Spring Laboratory Press.
4. Verma, A.S., Surajit, D and Anchal, S. (2014). Laboratory Manual for Biotechnology. New Delhi: S. Chand and Company Ltd.

COURSE OUTCOME:

- **CO1.** Understanding the theoretical explanation behind the experiment and learned about the detailed Principle followed by a detailed step by step Procedure.
- **CO2.** Gain hands-on experience on isolating genomic DNA and plasmid
- **CO3.** Gain hands on training on cloning strategy and gene transformation
- **CO4.** Hands on training on all the types of PCR
- **CO5.** Blotting techniques such as western, southern, northern techniques were learnt experimentally and DNA sequencing.

Cognetive Level

MGT15: LAB IN rDNA TECHNOLOGY			
Class	II M.Sc, MGT	Semester	III
Cognitive Level	K-2	Understand	20
	K-3	Apply	20
	K-4	Analyze	20
	K-5	Evaluate	20
	K-6	Create	20

Mapping

MGT15: LAB IN rDNA TECHNOLOGY															
CO/PO	**PO**					**PSO**									
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
CO1	**3**	**1**	**3**	**3**	**3**	**3**	**2**	**3**	**2**	**3**	**1**	**1**	**3**	**3**	**3**
CO2	**2**	**3**	**3**	**3**	**2**	**3**	**3**	**3**	**2**	**3**	**1**	**1**	**3**	**3**	**3**
CO3	**3**	**3**	**1**	**3**	**3**	**3**	**3**	**3**	**2**	**3**	**1**	**1**	**3**	**2**	**3**
CO4	**2**	**3**	**2**	**3**	**3**	**3**	**1**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**
CO5	**3**	**3**	**3**	**2**	**3**	**3**	**3**	**1**	**2**	**3**	**1**	**1**	**3**	**2**	**2**

3 - Strongly Correlated; 2 - Moderately Correlated; 1 - Weakly Correlated

SEMESTER-IV

Course Code: MGT16 **VIROLOGY** **Credits - 3**
Hours - 3

Course Objectives:

- The course contents are designed to understand the basic information about the viruses and their associated diseases based on the signs and symptoms.
- Helps the student to learn the process of virus latency and describe in molecular terms control of the process and activation of viral genomes during reactivation.
- Describe the growth behaviour differences between normal cells and cells transformed by oncogenic DNA and RNA viruses.

Unit - I: General Virology

Brief outline on discovery of viruses, nomenclature and classification of viruses; distinctive properties of viruses; morphology & ultrastructure; capsids &their arrangements; types of envelopes and their composition-viral genome, their types and structures; virus related agents(viroids, prions).

Unit - II: General Methods of Diagnosis and Serology.

Cultivation of viruses in embryonated eggs, experimental animals, and cell cultures; primary & secondary cell cultures; suspension cell cultures and monolayer cell cultures; cell strains, cell lines and transgenic systems; serological methods — haemagglutination & HAI; complement fixation; immunofluorescence methods, ELISA and Radioimmunoassays; assay of viruses - physical and chemical methods (protein, nucleic acid, radioactivity tracers, electron microscopy)- Infectivity assay (plaque method,end point method) - lnfectivity assay of plant viruses.

Unit - III: Bacterial Viruses

Bacteriophage structural organization; life cycle; one step growth curve; transcription; DNA replication; eclipse phase; phage production; burst size; lysogenic cycle; bacteriophage typing; application in bacterial genetics; brief details on M13,Mu,T3,T4, and Lamda P1.

Unit - IV: Plant Viruses

Classification and nomenclature; effects of viruses on plants; appearance of plants; histology, physiology and cytology of plants; common virus diseases of plants; paddy, cotton, tomato, and sugarcane; viruses of cyanabacteria, algae, fungi; life cycle; type species of plant viruses like TMV, Cauliflower Mosaic Virus and Potato Virus X; transmission of plant viruses with vectors

(insects, nematodes, fungi) and without vectors (contact, seed and pollens); diagnostic techniques in seeds; seed stocks and diseased plants (seed morphology, seedling symptomatology, indicator plants, serological methods, histochemical tests and fluorescent microscopy); prevention of crop loss due to virus infection-virus-free planting material; vector control.

Unit - V: Animal Viruses

Classification and nomenclature of animal human viruses; epidemiology, lifecycle, pathogenicity, diagnosis, prevention and treatment of RNA Viruses Picorna,Ortho myxo, Paramyxo, Toga and other arthropod viruses, Rhabdo,Rota, HIV and other Oncogenic viruses; DNA viruses; Pox, Herpes, Adeno, SV 40; Hepatitis viruses. viral vaccines (conventional vaccines, genetic recombinant vaccines used in national immunisation programmes with examples, newer generation vaccines including DNA Vaccines with examples) interterons, and antiviral drugs.

References:

1. Mathews, RE.,(1992) Functionals of Plant virology, Academic press, San Diego.

2. Dimmock NJ, Primrose SB (1994). Introduction to Modern Virology, IV Edition, Blackwell Scientific Publications, Oxford

3. Conrat HF, Kimball PC and Levy JA (1994) Virology-III Edition Prentice Hall, Englewood cliff, New Jersey.

4. Morag C and Timbury M.C (1994) Medical viroIogy-X Edition. Churchill Livingstone, London.

COURSE OUTCOME:

At the end of the course, learners will be able to:

- **CO1.** To know the basic concepts of viruses with its taxonomy, multiplication and the different types of animal viruses and its classification.
- **CO2.** To understand the basics of the learning of Virology and impart the knowledge regarding the diagnostics clinical aspects.
- **CO3.** To gain knowledge about newer emerging viral infections including the viral mutan forms for emerging.
- **CO4.** To understand the disease causing nature of different class of animal viruses, new emerging viral diseases, its pathogenesis and treatment methods.

Cognetive Level

MGT16: VIROLOGY			
Class	II M.Sc, MGT	Semester	IV
Cognitive Level	K-2	Understand	20
	K-3	Apply	20
	K-4	Analyze	30
	K-5	Evaluate	30

Mapping

MGT16: VIROLOGY															
CO/PO	**PO**					**PSO**									
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
CO1	**2**	**1**	**3**	**3**	**3**	**2**	**1**	**2**	**2**	**2**	**3**	**1**	**2**	**2**	**2**
CO2	**1**	**3**	**2**	**3**	**3**	**2**	**1**	**3**	**2**	**2**	**3**	**1**	**2**	**3**	**2**
CO3	**3**	**1**	**2**	**2**	**1**	**2**	**1**	**2**	**2**	**2**	**3**	**1**	**1**	**1**	**2**
CO4	**2**	**2**	**3**	**3**	**3**	**2**	**1**	**3**	**2**	**2**	**3**	**1**	**2**	**1**	**3**

3 - Strongly Correlated; 2 - Moderately Correlated; 1 - Weakly Correlated

ELECTIVES

SEMESTER -I

Course Code: MGTE01 **MEDICAL MICROBIOLOGY** **Credits - 4**
Hours - 4

Course Objectives:

- To acquire a basic understanding with the common infections and diseases of medical importance, their microbial causes, pathogenic action,
- Multiple assignment-task skill in the diagnosis of infection, the latter in the context of the treatment, epidemiology and prophylaxis of infectious diseases.
- To understand the fungal and protozaon diseses and preventive measures

Unit I: Host-Pathogen Interactions

Normal flora of human body- Skin, throat, gastrointestinal tract, urogenital tract; opportunistic and nasocomial infections; Host-pathogen interactions; Concept of epidemic- endemic, pandemic and syntemic- acute, chronic infectious diseases- morbidity, mortality, prevalence, incidence- Modes of transmission- Reservoirs, Carrier, vectors of pathogens. Early discovery of pathogenic microorganisms; development of bacteriology as scientific discipline; contributions made by eminent scientists. Classification of medically important micro organisms; Normal microbial flora of human body; role of the resident flora; normal flora and the human host.

Unit II: Bacterial diseases

Causative agent, mode of transmission, Pathogenesis, Laboratory diagnosis and prophylaxis of Bacteria: Gram negative bacteria – *Vibrio cholerae*, *Salmonella typhi, Pseudomonas aeruginosa, Klebsiella*, *Shigella* and Zoonotic infections.*Gram;* Gram positive bacteria - *Staphylococcus, Streptococci*, *Enterococci*, and *Corynebacterium;* Acid Fast bacteria- *Mycobacterium tuberculosis*; Anaerobic – *Clostridium tetani.*

Unit III: Viral diseases

Causative agent, mode of transmission, Pathogenesis, Laboratory diagnosis, and prophylaxis of DNA viruses –Herpes simplex virus, Hepatitis B virus; RNA viruses – Retrovirus – HIV, Polio, SARS-Viral zoonoses – Rabies. Swine Flu, Dengue fever, Chicken kunya, Zika virus, Nipah virus.

Unit IV: Fungal diseases and Antifungal therapy

Causative agent, mode of transmission, Pathogenesis, Laboratory diagnosis, and prophylaxis of Filamentous fungi **–** *Aspergillus niger,* Ringworm infections -*Tinea* sp. Non- filamentous fungi – *Candida albicans.* Antifungal Susceptibility testing-CLSI guidelines, Diagnosis of Fungal infections- Conventional and non-conventional methods, Current techniques in fungal diagnosis.

Unit V: Parasitic diseases

Morphology, life cycle, pathogenesis, lab diagnosis, and prevention of Protozoan *Intestinal Parasites - Entamoeba histolytica* and *Trichomonas.* Malarial parasite - *Plasmodium vivax.*

Morphology, life cycle, pathogenesis, lab diagnosis, and prevention of Intestinal Nematodes : a) *Ascaris lumbricoides, b) Taenia solium*; Tissue Nematode : a) *Wuchereria bancrofti* Classification and mechanism of action of antimicrobial agents: bacteria, viruses, fungi and parasites. Methods of testing drug sensitivity. Blood and tissue flagellates – *Leishmania donovani.*

Reference Books

1. Moo-Young, M., Anderson, W.A. and Chakrabarty, A.M. 1996. Environmental biotechnology: Principles and applications. Boston, Mass.: Kluwer Academic Publishers.
2. Wainwright, M. 1999. An introduction to environmental biotechnology. Boston, Mass. Klumer Academic Publishers.

COURSE OUTCOME:

Upon successful completion of this course the student will be able to:

- **CO1.**Understand mechanisms of infectious disease transmission, principles of aseptic practice, and the role of the normal microflora and understand the Host-microbe interactions
- **CO2.** Know pathogenic microorganisms and the mechanisms by which they cause disease in the humans.
- **CO3.** Skilled at diagnosis of bacterial, viral, protozoan and other parasitic diseases.
- **CO4.** Analyse the molecular biology of animal virus and various antiviral agents and describe the various types of parasite and its control measures

Cognetive Level

MGTE01: MEDICAL MICROBIOLOGY			
Class	I M.Sc, MGT	Semester	I
Cognitive Level	K-2	Understand	20
	K-3	Apply	20
	K-4	Analyze	30
	K-5	Evaluate	30

Mapping

MGTE01: MEDICAL MICROBIOLOGY															
CO/PO	**PO**					**PSO**									
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
CO1	**2**	**1**	**3**	**1**	**3**	**2**	**1**	**2**	**2**	**2**	**3**	**1**	**2**	**2**	**2**

CO2	**3**	**2**	**2**	**3**	**3**	**2**	**1**	**3**	**2**	**2**	**3**	**1**	**2**	**2**	**2**
CO3	**1**	**1**	**2**	**2**	**2**	**2**	**1**	**2**	**2**	**1**	**3**	**1**	**1**	**1**	**2**
CO4	**3**	**2**	**3**	**1**	**3**	**2**	**1**	**3**	**2**	**2**	**3**	**1**	**1**	**1**	**3**

3 - Strongly Correlated; 2 - Moderately Correlated; 1 - Weakly Correlated

Course Code: MGTE02 **Mycology and Phycology** **Credits - 4**
Hours - 4

Course Objectives

- The course contents are designed to understand the basic information about the fungi and their associated diseases based on the signs and symptoms.
- To Learn about classification, characteristics and importance of algae.

Unit - I

Historical introduction to mycology structure and cell differentiation. Division myxomycota Acrasiomycetes, hydromyxomycetes, myxomycetes, Plasmo-diophoromycetes. Zoosporic fungi-Chytridiomycetes, Hypochytridiomycetes, oomycetes. Zygomycotina - Zygomycetes, Trichomycetes -Evalutionary tendencies in lower fungi.

Unit - II

Ascomyctina - Hemiascomycetes, plectomycete, pyrenomycetes Discomycetes, laboulberiomycetes, oculoascomycetes. Basidiomycotina teliomycetes, hymenomycetes. Deuteromycotina hypomycetes, coelomycetes, blastomycetes.

Unit - III

Heterothalism, sex hormones in fungi.Physiological specialization phylogeny of fungi, Lichens - ascolichens, basidiolichens, deuterolichens. Mycorrhiza - ectomycorrhiza, endomycorrhiza, vesicular arbuscular mycorrhiza.fungi as insect symbiont, Fungal diseases - mycoses systemic and subcutaneous, candidiasis, Pneumocystis, blastomycoses, dermotophytosis.

Unit – IV: Fungi and ecosystem

Trichoderma spp – Beneficial effects and its environment impact. Distribution, pathogenecity disease development in plants by *Rhizoctonia solani*, *Helminthoporium oryzae*, *Macrophomina phaseolina*, *Fusarium oxysporum*, *Alternaria alternate* and *Pyricularia oryzae*.

Unit - V

Distribution of algae, classification of algae - F.E. Fritsch, algal nutrition, algal thallus, algal reproduction, greenalgae, diatoms, euglenoids, brown Rhodophyta, pyrrophyta. Algal ecology and algal biotechnology.

Text Books

1. Alexopoulos, C.J. and C.W. Mims 1979. Introduction to Mycology (3'° Ed.) Wiley Eastern Ltd., New Delhi.
2. Mehrotra, R.S. and K.R, Aneja 1990. An Introduction to Mycology. New Age International publishers.

COURSE OUTCOME:

At the end of the course, learners will be able to:

CO1. To understand the basic aspects of fungi with its taxonomy, various fungal databases, know about fungal immunity and the methods used in the specimen collections.

CO2. Know about the different classes of antifungals, their mode of action, methods followed in diagnosis of fungal infections and its treatment.

CO3. Know about the different types of fungal infections, properties of the fungi causing these infections, the diagnostics methods and the treatment of these infections.

CO4. To learn about algae and its benefits to environment and To know about different molecular approaches involved microalgae to enhance its application.

Cognetive Level

MGTE02: MYCOLOGY AND PHYCOLOGY			
Class	I M.Sc, MGT	Semester	I
Cognitive Level	K-1	Remember	20
	K-2	Understand	30
	K-3	Apply	20
	K-4	Analyze	30

Mapping

MGTE02: MYCOLOGY AND PHYCOLOGY															
CO/PO	**PO**					**PSO**									
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
CO1	**2**	**2**	**1**	**3**	**3**	**1**	**3**	**2**	**2**	**2**	**3**	**2**	**2**	**2**	**2**
CO2	**2**	**2**	**3**	**1**	**3**	**1**	**3**	**2**	**2**	**2**	**3**	**2**	**2**	**2**	**2**
CO3	**2**	**1**	**2**	**3**	**2**	**2**	**1**	**2**	**2**	**1**	**3**	**1**	**2**	**1**	**2**
CO4	**3**	**2**	**3**	**1**	**3**	**2**	**1**	**3**	**2**	**2**	**3**	**1**	**3**	**1**	**3**

3 - Strongly Correlated; 2 - Moderately Correlated; 1 - Weakly Correlated

SEMESTER –II

Course Code: MGTE03 FERMENTATION TECHNOLOGY Credits - 4
Hours - 4

Scope

This paper provides knowledge on principles and methods in industrial microbiology.

Course Objectives:

- The aim of fermentation technology course is to know current bio-resources and their exploitations on the production of microbial products.
- The main objective of this course is to train students practically in basic principles of food and industrial microbiology.
- The content of the precise course include nature of the bio-resources, industrially important microorganisms, up and down stream process, functions of the fermentors, primary and secondary metabolites and production of recombinant products..

Unit I: Microbial Metabolites

General Considerations: Metabolic pathways and metabolic control mechanisms, primary and secondary metabolites.

Unit II: Growth kinetics

Fermentation in batch culture: Microbial growth kinetics, measurement of growth (cell number, direct and indirect methods) growth and nutrient, growth and product formation, heat evolution, effect of environment (temperature, pH, high nutrient concentration) media formulation. Sterilization, kinetics of thermal death of micro-organisms, batch and continuous sterilization.

Unit III: Continuous culture

Continuous culture system, productivity, product formation. Microbial strains, substrates, strain improvement, flow diagrams, product optimization, and applications of industrial alcohol (ethanol and butanol), amino acids (lysine, phenylalanine, tryptophan), antibiotics (cephalosporins, tetracyclines, polyenes), enzymes and immobilized enzymes, SCP, microbial polyesters, biosurfactants, and recombinant products (insulin, somatostatin, thaumatin).

Unit IV: Fermentation process

Aeration and agitation, power requirement oxygen transfer kinetics, concepts of Newtonian and Non-Newtonian fluids, plastic fluids apparent viscosity, foam and antifoam.

Unit V: Fermentation conditions

Scale-up, instrumentation control, physical and chemical environment sensors, downstream process.

References

1. Stanbury, P.F., Whitaker, W. and Hall, S.J., (1997). Principles of Fermentation Technology. Aditya Books (P) Ltd., New Delhi.

2. Mansi, E.I., Bryce, T and Francis, (1999). Fermentation Microbiology and Biotechnology. London, Philadelphia.
3. Crueger, W., and Crueger, A., (2000). Biotechnology: A Text Book of Industrial Microbiology, Panima Publishing Corporation, New Delhi/Bangalore.
4. Okafer, N., (2007). Modern Industrial Microbiology & Biotechnology. Scientific Publishers, Enfield, USA.

Course Outcome:

After completion of this course the student can able to

- **CO1.** Understand the basics of microbial metabolites in industry and its economic importance
- **CO2.** Apply the knowledge of molecular biology and microbial genetics to develop industrially important microorganism
- **CO3.** The course will also provide meticulous ideas on different types of fermentors and their functions.
- **CO4.** Use the most common equipment, materials and methods related to fermentation processes, microbial growth and cultivation and sterilization.

Cognetive Level

MGTE01: MEDICAL MICROBIOLOGY			
Class	I M.Sc, MGT	Semester	II
Cognitive Level	K-2	Understand	30
	K-3	Apply	30
	K-4	Analyze	20
	K-5	Evaluate	20

Mapping

MGTE01: MEDICAL MICROBIOLOGY															
CO/PO	**PO**					**PSO**									
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
CO1	**2**	**1**	**3**	**1**	**3**	**2**	**1**	**2**	**2**	**2**	**3**	**1**	**2**	**2**	**2**
CO2	**3**	**2**	**2**	**3**	**3**	**2**	**1**	**3**	**2**	**2**	**3**	**1**	**2**	**1**	**2**
CO3	**2**	**1**	**2**	**1**	**2**	**2**	**1**	**2**	**2**	**1**	**3**	**1**	**2**	**1**	**2**
CO4	**3**	**2**	**3**	**2**	**3**	**2**	**1**	**3**	**2**	**2**	**3**	**1**	**1**	**1**	**3**

3 - Strongly Correlated; 2 - Moderately Correlated; 1 - Weakly Correlated

Course Code: MGTE04 Microbial Diversity and Extremophiles **Credits - 4**
Hours - 4

Course Objectives:

- The aim of the course is to know microbial distribution and molecular diversity studies.
- The main objective of this course is to train understand microbial bioremediation and various extremophilic condition.

UNIT-I: Microbial diversity

Introduction to microbial diversity - distribution - abundance - ecological niche. Oxygenic photosynthetic microbes - anoxygenic photosynthetic microbes - Oxidative transformation of metals - sulphur oxidation, iron oxidation, ammonia oxidation and hydrogen oxidation.

UNIT-II: Molecular methods

Unculturable and culturable bacteria - conventional and molecular methods of studying microbial diversity – RFLP, RAPD, AFLP and BOX-PCR.

UNIT-III: Microbial diversity in anoxic ecosystem

Methanogens - reduction of carbon monoxide - reduction of iron, sulphur, manganese, nitrate and oxygen - microbes and mechanism of metal reduction - bioleaching of ore metal corrosion. Microbial transformation of carbon, phosphorus, sulphur, nitrogen and mercury.

UNIT-IV: Extremophiles

Acidophilic, alkalophilic thermophilic, barophilic and osmophilic microbes- mechanisms and adoption. Halophiles - membrane variation - electron transport- application of thermophiles and extremophiles.

UNIT-V: Subterranean microbes

Ground water contamination and microbial transformations. Biomagnification, bioaccumulation and bioremediation. Catabolic pathway of recalcitrant molecule degradation and mineralization.

References:

1. Colwd, D. 1999. Microbial Diversity. Academic Press
2. Johri, B.N. 2000. Extremophiles. Springer Verlag. New York

COURSE OUTCOME:

On the successful completion of the course, students will be able to

- **CO1.** Study of distribution, diversity, and microbial transformation process
- **CO2.** Understand the different extrimophiles and bioremediation of microorganisms

Cognetive Level

MGTE04: MICROBIAL DIVERSITY AND EXTREMOPHILES			
Class	I M.Sc, MGT	Semester	II
Cognitive Level	K-1	Remember	20
	K-2	Understand	30
	K-3	Apply	20
	K-4	Analyze	30

Mapping

MGTE04: MICROBIAL DIVERSITY AND EXTREMOPHILES															
CO/PO	**PO**					**PSO**									
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
CO1	**2**	**2**	**3**	**3**	**3**	**1**	**3**	**2**	**2**	**3**	**3**	**2**	**3**	**2**	**2**
CO2	**2**	**2**	**3**	**3**	**3**	**2**	**3**	**2**	**3**	**2**	**3**	**2**	**2**	**2**	**2**

3 - Strongly Correlated; 2 - Moderately Correlated; 1 - Weakly Correlated

SEMESTER -III

Course Code: MGTE05 **MICROBIAL "OMICS"** **Credits - 4**
Hours - 4

Scope

This paper provides the knowledge in principles and methods in genomics and proteomics.

Course Objective:

- The main objective of the paper is to expose students on applications of "omics" various fields of biotechnology, medicine and research areas.

Unit I: Microbial Genome organization and sequencing- Structure and organization of microbial genomes, genome size, elements of microbial genomes, pulsed field gel electrophoresis, genome mapping- physical and genetic mapping, Genome sequencing strategies, Next-Gen sequencing, genome assembly, gap closure, Single molecule sequencing.

Unit II: Functional genomics of microorganisms- Genome annotations, ORF prediction, RNA prediction, comparative genomics, clusters of orthologous groups (COG), Pathway databases, Metacyc, EcoCyc, KEGG, Gene inactivation, expression analyses, differential gene expression in prokaryotes, DNA-protein interactions, micro arrays, serial analysis of gene expression (SAGE), Representational difference analysis (RDA), Rapid amplification of cDNA ends (RACE), Concept of metagenomics and its applications.

Unit III: Pathogenomics & drug discovery-Genomics of bacterial pathogens, virulence factors, pathogenecity islands, Signature tagged mutagenesis, In vivo expression technology (IVET), In vivo induced antibody technology (IVIAT), Reverse Vaccinology, multitope vaccines, vaccinome, genomics and drug development, human microbiomics, roles of microbiome in human health and diseases.

Unit – IV: Microbial Proteomics-Two-dimensional gel electrophoresis- principle Method application; HPLC – LC-MS; Mass Spectrometry-Ionization Method & Types of Mass analyser; isotope Labeling in Quantitative Proteomics- *In -vitro* labelling, Protein identification by peptide Mass Fingerprinting; Peptide Sequence Analysis by Tandem Mass Spectrometry; Protein Identification with tandem Mass; protein – protein interaction; Yeast two hybrid systems, phage display, Protein microarray

Unit – V: Microbial Metabolomics-Metabolome, Metabolic labelling, metabolite identification, pathway identification and pathway integration, HPLC and FPLC based approaches in metabolomics. Criteria for the selection of chromatography methods for metabolomics. Metabolite profiling for infectious diseases. Analytical considerations, and biological aspects and applications.

References

1. Daniel Liebler, 2001. Introduction to Proteomics: Tools for the New Biology, Springer Science & Business Media.
2. Jizhong Zhou (Ed.).2004. Microbial Functional Genomics, John Wiley & Sons.
3. Brown. T.A. 2007. Genomes 3. Garland Science Publications.
4. Claire M. Fraser, Timothy Read, Karen E. Nelson, 2010. Microbial Genomes. Humana Press.

COURSE OUTCOME:

On the successful completion of the course, students will be able to

- **CO1.** Knowledge with microbial genomes, mapping and different genome analysis and their applications
- **CO2.** Understand the drug discovery, vaccine production and role of microbiome in human health and diseases.
- **CO3.** Apply the microbial metabolites to analyze with different chromatography, spectrometry and in silico analysis.
- **CO4.** Identify the microbial metabolomics pathways and interaction, their biological applications.

Cognetive Level

MGTE05: MICROBIAL "OMICS"			
Class	II M.Sc, MGT	Semester	III
Cognitive Level	K-1	Remember	20
	K-2	Understand	30
	K-3	Apply	20
	K-4	Analyze	30

Mapping

MGTE05: MICROBIAL "OMICS"															
CO/PO	**PO**					**PSO**									
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
CO1	**3**	**2**	**3**	**1**	**3**	**1**	**3**	**2**	**2**	**3**	**3**	**2**	**3**	**2**	**2**
CO2	**2**	**2**	**3**	**2**	**3**	**2**	**3**	**2**	**3**	**2**	**3**	**2**	**2**	**2**	**2**
CO3	**2**	**1**	**2**	**3**	**2**	**2**	**1**	**2**	**2**	**1**	**3**	**1**	**2**	**1**	**2**
CO4	**2**	**2**	**3**	**2**	**3**	**2**	**1**	**3**	**2**	**2**	**3**	**1**	**1**	**1**	**3**

3 - Strongly Correlated; 2 - Moderately Correlated; 1 - Weakly Correlated

Course Code: MGTE06 **MICROBIAL TECHNOLOGY** **Credits - 4**
Hours - 4

Course objective:

- The primary objective of this course is to make the students know about the principle behind the instruments and to acquaint them with the fundamentals of research methods.
- To learn the microbial antibiotics, vitamins, industrial enzymes and large production in fermentation process.

UNIT – I: Industrial process

Biotechnological innovations in the chemical industry, biocatalyst in organic chemical synthesis, efficiency of growth and product formation, growth stoichiometry, maintenance energy requirement and maximum biomass, yield, P/O quotients, metabolite overproduction and growth efficiency.

UNIT – II: Industrial Products

Shake flask, stirred tank airlift fermenter, fed batch, continuous and immobilised cell reactor. Large scale production. Production of antibiotics vitamins definition, classification of antibiotics and biochemistry, penicillin, streptomycin, tetracycline's, geriosofulvin, cephalosporin, ampicillin, piocyanase, vitamins-A, Riboflavin, cephalosporin, valinomycin, carotenoids, Solvents, biopolymers and microbial insecticides solvents, ethylalcohol, glycerol, acetone, butanol, 2, 3 butandiol, Biopolymers – expolysacharides, alaganides xanthan, dextran, curdlan polyhydroxybutrate.

UNIT – III: Metabolic pathways

Metabolic pathways and metabolic control mechanism, industrial production of citric acid, enzymes, ethanol, acetic acid, production and diversification of antibodies. Steroids.

UNIT – IV: Microbial applications

Biofertilizers, biopesticides, mushroom production, fermented food beverages. Biopolymers. Bioremediation.

UNIT – V: Strain improvement and large scale production

Industrial strains. Strategies tor selection and improvement, maintenance containment of recombinant organisms, large scale production using recombinant microorganisms. Product recovery.

References:

1. Patel. A.H. 1966. Industrial Microbiology, Mac Millan India Ltd.
2. Sven-Olof Enfors, Lena Häggström. Bioprocess Technology: Fundamentals and Applications, Royal Institute of Technology, 2000.
3. Peter f stanbury, Allan Whitaker Priciples of fermentation Technology, 2003.
4. Wulf Cruger and Anneliese Cruger., Biotechnoloogy, (A text book of industrial Microbiology), Panima Publishers, New Delhi, 2nd edition, 2003.

COURSE OUTCOME:

Upon successful completion of the course, the student:

CO1. Understand the basics in microbial growth requirements and conditions

CO2. Will learn about industrial production of antibiotics, vitamins and solvents

CO3. Apply the products in biofertlizer, biopesticide, bioremediation involved microbes and their agricultural importance

Cognetive Level

MGTE06: MICROBIAL TECHNOLOGY			
Class	II M.Sc, MGT	Semester	III
Cognitive Level	K-1	Remember	20
	K-2	Understand	30
	K-3	Apply	20
	K-4	Analyze	30

Mapping

MGTE06: MICROBIAL TECHNOLOGY															
CO/PO	**PO**					**PSO**									
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
CO1	**3**	**2**	**3**	**1**	**3**	**1**	**3**	**2**	**2**	**3**	**3**	**2**	**3**	**2**	**2**
CO2	**2**	**2**	**3**	**2**	**3**	**2**	**3**	**2**	**3**	**2**	**3**	**2**	**2**	**2**	**2**
CO3	**2**	**1**	**2**	**3**	**2**	**2**	**1**	**2**	**2**	**1**	**3**	**1**	**2**	**1**	**2**

3 - Strongly Correlated; 2 - Moderately Correlated; 1 - Weakly Correlated

SEMESTER -IV

Course Code: MGTE07 **MICROBIAL GENOMICS** **Credits - 4**
Hours - 4

Course Objective:

- The objective of this course is to provide a compressive knowledge of Microbial Genomes and the recent trends in Microbial Genomics research.
- Understand the detailed view of the organization and functions of genomes will be showcased. All the recent research tools in the genomics will be taught.

UNIT-I

Microbial Ecology: Terrestrial Environmental Micro organisms: Formation of different soils and Environment interaction – Microorganims movement between ecosystem; Methods in microbial ecology – Bio-geo chemical and biological aspects and Micro organism association with plant system.

UNIT-II

Microbial Genomics: Introduction; Characteristics of Microbial Genomes –Importance of microbial functional genomics of Prokaryotes and Eukaryotes.Genomic diversity within the species; Genome annotation. Evaluation of Protein and RNA-Level gene expression; Future of microbial genomics.

UNIT-III

Microbial metabolites: Introduction; From bacterial genomics to Meta genomics: concept, tools and recent advances; Secondary metabolites produced by Bacteria and Fungi; Plant Growth hormones production from Bacteria and Fungi. Mechanism of Plant growth promotion and Biological control- Antibiosis, Competition, Parasitism, Hydrogen Cyanide, Siderophore and Plant systemics- Induced systemic resistance (ISR), Systemic Acquired Resistance (SAR);Nitrogen fixation (Bacteria and Fungi).

UNIT- IV

Microbial Metagenomics in Animal System – Introduction: Genomics on Antimicrobial drug discovery and Toxicology; Antimicrobial Chemotherapy; Genereal character of antimicrobial drugs and their mechanism in animal system; Mechanism of drug resistance; antimicrobial drug agents, anticancer drug. Metagenomics of gut: insects, mouse and human beings.

UNIT-V

Molecular techniques and genomic analysis - Techniques for isolation, purification and identification of compounds from bacteria and Fungi ; Polymerase chain reaction (RFLP, RAPD); Micro array technology, Genome sequence (16s rRDNA, 16s rRNA Phylogenitic tree constraction- Sequence base analysis, Functional based analysis, Hetrologous expression, Identifying active clones - clone screens, selection and functional anchors, Challenges of metagenomics - genomics data, meta genomics data, the importance of metadata, databases for metagenomics analysis of meta genomics sequence data.

Reference

1. Microbial Technology-Microbial Processes; Second Edition; Volume 1, Edited by H.J. Peppler and D. Perlman; Published by Academic Press, An imprint of Elsevier.
2. Microbial Functional Genomics: Edited by Jiz Hong Zhou, Dorothea K.Thompson, Ying Xu, James M. Tiedje. Published by Wiley- Liss Publication.
3. Microbiology; Fith edition, Wrote by Lansing M. Prescott, John P. Harley and Donald A. Klein: Published by McGraw-Hill Higher Education.
4. Microbial Genomics; Edited by Claire M.Fraser, Timothy D.Read , Karen E.Nelson: Published by Humana Press.
5. Functional genomics of Micro organism: Published by Springer Verlag .
6. Secondary metabolites production by Plant growth promoting rhizobacterium: Published by Springer Verlag.
7. Molecular diversity and ecology of microbial plankton: Published by Stephen J. Giovannoni & Ulrich Sting: Nature; Insight Review.
8. Metagenomics: Sequence from the Environment, NCBI.

COURSE OUTCOME:

After completing this course, students will be able to

- **CO1.** Understand the methods used in the field of microbial genomics, including metagenomics and human microbiomics.
- **CO2.** Annotate microbial genomes and metagenomes.
- **CO3.** Use bioinformatics resources for microbial genomics research
- **CO4.** To apply the molecular techniques and tools

Cognetive Level

MGTE07: MICROBIAL GENOMICS			
Class	II M.Sc, MGT	Semester	IV
Cognitive Level	K-2	Understand	20
	K-3	Apply	30
	K-4	Analyze	30
	K-5	Evaluate	20

Mapping

MGTE07: MICROBIAL GENOMICS															
CO/PO	**PO**					**PSO**									
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
CO1	**3**	**3**	**3**	**2**	**3**	**3**	**3**	**2**	**1**	**2**	**2**	**2**	**3**	**3**	**3**
CO2	**3**	**2**	**3**	**3**	**3**	**3**	**2**	**3**	**1**	**1**	**1**	**1**	**1**	**3**	**3**
CO3	**3**	**3**	**3**	**3**	**1**	**3**	**2**	**3**	**1**	**1**	**3**	**1**	**1**	**2**	**3**
CO4	**3**	**3**	**2**	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**2**	**1**	**2**	**2**	**3**

3 - Strongly Correlated; 2 - Moderately Correlated; 1 - Weakly Correlated

MICROBIAL MOLECULAR DIAGNOSTICS AND THERAPEUTICS

Course Code: MGTE08 **Credits - 4**
Hours - 4

Course Objectives:

- Learn the molecular tools and diagnostics methods in human diseases
- Understand the drug discovery by various microbial metabolites and advantages in high throughput techniques

UNIT – I: Molecular typing methods

Diagnostic methods for infectious diseases. Traditional molecular typing methods- plasmid profiling- Restriction fragment length polymorphism (RFLP) - Amplified fragment length polymorphism (AFLP)- PCR ribotyping –toxinotyping- flic C, slpA and multilocus sequence typing. Pulse field gel electrophoresis (PFGE) and Microarray. Molecular detection of *Mycobacterium tuberculosis* & HIV– variable number of tandem repeats (VNTR). Molecular methods & detection of H5N1.

UNIT – II: Microbial Molecular Epidemiology

Definition of epidemiology– molecular epidemiology- Multi locus enzyme electrophoresis (MLEE)- parasites and other pathogens- isoenzymes –isoenzymes migrate differentiate in electrophoresis, protein electric charge- isoenzymes staining- isoenzymes analysis in parasitology. Plasmid replicon properties Multi locus sequence typing (MLST).Targets of molecular epidemiology-relevant species-subspecies, strains clones and genes. Random amplified DNA analysis Basic biology of pathogens. Enzyme electrophoresis DNA analysis in Duchenne Muscular Dystrophy – Molecular diagnostic method for Sickle cell anemia, Cystic fibrosis, X-linked CGD. Molecular cytogenetics:FISH. Prenatal molecular diagnostics: CVS and amniocentesis. Chromosomal aberration and disorders.

UNIT – III: **Molecular diagnostics of pathogens**

Serological and ELISA based methods. Discrimination of foodborne pathogens- Repetitive element palindromic PCR (rep-PCR)-Pulse-field gel electrophoresis. Molecular genotyping of microbes-multilocus PCR - Clustered Regularly Interspaced Short Palindromic Repeats (CRISPRs).

UNIT – IV: **Types of drug discovery assays**

Advantages and limitations of cellular assays–High throughput and high content screening methods-Bacterial and fungal in drug screening and evaluation- optimization-Sources of drugs – Bacterial and fungal derived drugs- mode of action of drugs - Bioavailability- ADME- Therapeutic index – Adverse drug effects – Drug resistance.

UNIT – V: **Types of drugs and mode of actions**

Anti-inflammatory, Anti-bacterial and anti-fungal drugs – Anaesthetic agents - Anti-ageing drugs – Anti-cancer drugs, Anti-diabetics Other drugs - Nanotherapeutics and Nanomedicine – Gene therapy: the current status –Targeted therapeutics - Nutritional Therapeutics - Dietary supplements and the impact on therapeutic response – Calorific value of major food types – Myths and facts in traditional medicine - Lifestyle drugs.

References:

1. Biomedical Methods Handbook- John M. Walker, Ralph Rapley. Humana Press, 2005
2. Dominique A. Caugant. 2009. Molecular Epidemiology of Microorganisms-Methods and Protocols. Human Press, Springer Science.
3. Current Medical Diagnosis and Treatment 2013.Stephen J Mc Phee ,M A Papadakis Eds.

COURSE OUTCOME:

After completing this course, students will be able to

- **CO1.** Understand the molecular techniques and diagnosis in different diseases.
- **CO2.** Annotate microbial genomes and chromosomal aberration.
- **CO3.** Use molecular diagnostic methods with various PCR analysis
- **CO4.** To apply the drug discovery using high throughput instruments and gene therapy.

Cognetive Level

MGTE08: MICROBIAL MOLECULAR DIAGNOSTICS AND THERAPEUTICS			
Class	II M.Sc, MGT	Semester	IV
Cognitive Level	K-3	Apply	30
	K-4	Analyze	30
	K-5	Evaluate	20
	K-6	Create	20

Mapping

MGTE08: MICROBIAL MOLECULAR DIAGNOSTICS AND THERAPEUTICS															
CO/PO	**PO**					**PSO**									
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
CO1	**3**	**3**	**3**	**2**	**3**	**3**	**3**	**2**	**1**	**2**	**2**	**2**	**3**	**3**	**3**
CO2	**3**	**3**	**2**	**3**	**3**	**3**	**2**	**3**	**1**	**1**	**3**	**1**	**1**	**3**	**3**
CO3	**3**	**2**	**3**	**3**	**1**	**3**	**2**	**3**	**1**	**1**	**3**	**1**	**1**	**2**	**3**
CO4	**3**	**3**	**2**	**3**	**3**	**3**	**3**	**3**	**2**	**2**	**2**	**1**	**2**	**2**	**3**

3 - Strongly Correlated; 2 - Moderately Correlated; 1 - Weakly Correlated

Soft Skill Courses offered from our Department

Course Code: MGTNE01 MICROBIAL NANOTECHNOLOGY Credits - 3
Hours - 3

Scope
This paper provides the student a thorough knowledge in principles of nanotechnology.

Course Objectives:
- ❖ Detailed introduction about history of nanotechnology and its development.
- ❖ Synthesis of nanoparticles and its vast applications.
- ❖ Different characterization methods for nano particles to know about its physical and chemical properties

Unit I: Nano-Biomaterials: Introduction - Biocompatibility – anti bacterial activity – principles involved – Applications. Biomaterial nanocircuitry; Protein based nanocircuitry; Neurons for network formation. DNA nanostructures for mechanics and computing and DNA based computation; DNA based nanomechanical devices.

Unit II: Nano-Biotechnology: Interaction between bimolecules and nanoparticle surface, Different types of inorganic materials used for the synthesis of hybrid nano-bio assemblies, Application of nano in biology, nanoprobes for Analytical Applications-A new methodology in medical diagnostics and Biotechnology, Current status of nano Biotechnology, Future perspectives of Nanobiology, Nanosensors.

Unit III: Nanomedicines: Developing of Nanomedicines, Nanosytems in use, Protocols for nanodrug Administration, Nanotechnology in Diagnostics applications, materials used in Diagnostics and Therapeutic applications - Molecular Nanomechanics, Molecular devices, Nanotribology, studying tribology at nanoscale, Nanotribology applications.

Unit IV: Molecular And Cellular Biology:Molecular and Cellular biology and Applications, 2-D electrophoresis and mass spectrometry of proteins, Protein microarrays (fabrication-fluorescence detection)-Binding assays and immunosensors- Integrated Nano biotechnology systems.

UNIT V: Biological Methods of Synthesis**:** Use of bacteria, fungi, Actinomycetes for nanoparticle synthesis, Magnetotactic bacteria for natural synthesis of magnetic nanoparticles; Mechanism of formation; Viruses as components for the formation of nanostructured materials; Synthesis process and application, Role of plants in nanoparticle synthesis

Reference Books

1. David S. Goodsell,2004. Bionanotechnology: Lessons from Nature, John Wiley & Sons.
2. Hari Singh, N. 2005. Handbook of Nanostructured Biomaterials and Their Applications in Nanobiotechnology, American Scientific Publishers
3. Christof M. Niemeyer, Chad A. Mirkin (Eds.). 2006 Nanobiotechnology, John Wiley & Sons.

4. Robert A. Freitas, 2009. Nanomedicine, Volume 2 , Landes Bioscience Publications.

Course Outcomes:

After completion of the course would be able,

- **CO1.** To carry out the latest environmentally friendly research to human welfare.
- **CO2.** To give brief introduction about different analytical instruments.
- **CO3.** To assess types of nanoparticles for various medical research to find out the solution of human diseases.
- **CO4.** To Physical and chemical properties of nanoparticles give idea about the biological process.
- **CO5.** To motivate the researchers to carry the better advanced research on this field and gain a better knowledge about targeting drug delivery by nanoparticles.

Cognetive Level

MGTNE01: MICROBIAL NANOTECHNOLOGY			
		Semester	I
Cognitive Level	K-3	Apply	30
	K-4	Analyze	30
	K-5	Evaluate	20
	K-6	Create	20

Mapping

MGTNE01: MICROBIAL NANOTECHNOLOGY															
CO/PO	**PO**					**PSO**									
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
CO1	**3**	**3**	**3**	**2**	**3**	**1**	**3**	**2**	**1**	**2**	**2**	**2**	**3**	**3**	**3**
CO2	**3**	**3**	**2**	**1**	**3**	**3**	**3**	**3**	**1**	**1**	**3**	**1**	**1**	**3**	**3**
CO3	**3**	**3**	**1**	**1**	**3**	**3**	**3**	**3**	**1**	**1**	**3**	**1**	**1**	**2**	**3**
CO4	**3**	**3**	**3**	**2**	**3**	**1**	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**3**
CO5	**3**	**2**	**3**	**3**	**2**	**3**	**3**	**3**	**1**	**3**	**1**	**3**	**3**	**3**	**3**

3 - Strongly Correlated; 2 - Moderately Correlated; 1 - Weakly Correlated

Course Code: MGTNE02 **DEVELOPMENTAL BIOLOGY** **Credits - 3**
Hours - 3

Course Objectives:

- Understand Historic Background of developmental biology
- Understand current role of developmental Biology in scientific research
- Brief understanding of Cell Structure and Function

UNIT-I

The stages of animal development, Human spermatogenesis and oogenesis, Structure of the human sperm and the egg, Molecular events during mammalian fertilization: Action at a distance, Induction of the mammalian acrosomal reaction, Translocation and capacitation, Hyperactivation and chemotaxis, Fusion of genetic material in mammals, Prevention of Polyspermy.

UNIT-II

An introduction to early developmental processes in mammals: The unique nature of mammalian cleavage, Mammalian gastrulation, Formation of extra embryonic membranes, Mammalian anterior-posterior axis formation, Mammalian dorsal-ventral and left-right axes formation.

UNIT-III

Chromosomal sex determination in mammals: Primary and secondary sex determination, Temperature dependent sex determination in reptiles, Induction and competence. Postembryonic development- Metamorphosis of frog: Morphological changes associated with metamorphosis, Biochemical changes associated with metamorphosis, Epimorphic regeneration of Salamander limbs.

UNIT-IV

Embryological origins of the gene theory, Mechanism of X chromosome inactivation, Theories of ageing: Evolutionary theories of ageing, integrated theory of ageing in the nematode *Caenorhabditis elegans.*

UNIT-V

Properties of stem cells, Pluripotency of human embryonic stem cells, embryonic stem cell lines, Hematopoietic stem cells, Markers commonly used to identify stem cells, embryonic stem cells and their applications.

References:

1. Jonathan, M.W. Essential Developmental Biology. Wiley Blackwell Publishers, 1991.
2. Longo.F.J. Fertilization. Chapman and Hall publishers, New York.1997.
3. Scott F. Gilbert. Developmental Biology. Sinaver Associates, INC Publishers, Sunderland. 2000.
4. Balinsky, B.I. An Introduction to Embryology.W. B.Saunders Publishing Company.2004

COURSE OUTCOME:

- **CO1.** Account for the structure and function of the prokaryotic and eukaryotic cell and its organelles.
- **CO2.** Account for cell motility and regulation of cell form and movement
- **CO3.** To describe origin theory and evolutionary theory of ageing.
- **CO4.** To understand the human stem cell and their applications.

Cognetive Level

MGTNE02: DEVELOPMENTAL BIOLOGY			
		Semester	II
Cognitive Level	K-2	Understand	30
	K-3	Apply	30
	K-4	Analyze	20
	K-5	Evaluate	20

Mapping

MGTNE02: DEVELOPMENTAL BIOLOGY															
CO/PO	**PO**					**PSO**									
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
CO1	**2**	**1**	**3**	**2**	**3**	**2**	**1**	**3**	**2**	**2**	**1**	**3**	**2**	**2**	**2**
CO2	**1**	**1**	**3**	**3**	**1**	**2**	**1**	**3**	**2**	**2**	**1**	**3**	**2**	**1**	**2**
CO3	**1**	**1**	**2**	**3**	**3**	**2**	**1**	**3**	**2**	**2**	**1**	**1**	**3**	**2**	**3**
CO4	**2**	**1**	**3**	**3**	**2**	**2**	**1**	**3**	**2**	**2**	**1**	**3**	**3**	**2**	**3**

3 - Strongly Correlated; 2 - Moderately Correlated; 1 - Weakly Correlated

Course Code: MGTNE 03 ECOLOGY AND EVOLUTIONARY BIOLOGY **Credits - 3**
Hours - 3

Course Objectives:

- To study the ecosystem energy, ecological pyramids and food chain in enviroment
- The use of microbial population in agriculture, mineral recovery, management of various types of pollutants and conversion processes of various types of wastes into value-added products will be discussed.

UNIT – I

Ecosystem function: Energy flow in ecosystem, energy vs. emergy, food chain, food web and ecological pyramids; Productivity in terrestrial and aquatic ecosystems - **Origin of life:** Abiotic origin of life with reference to Miller's experiment, physical and chemical catalysis of formation of macromolecules, Oparin's 'proteinoid droplet' concept and Crick's 'Nucleic acid first' hypothesis.

UNIT – II

Population Ecology: Characteristics of population, population growth curves, *r* and *k* selections, population regulation by density-dependent and density-dependent factors, concept of self-regulation of population - Geological era**:** Climatic, floral and faunal characteristics of different geological era.

UNIT – III

Community ecology: Habitat and niche concept; Keystone species and dominant species; Ecotone and edge effect; Heterospecific associations with reference to competition, protocooperation, commensalism and mutualism - Classical theories of evolution**:** Critical review of Lamarckism, Darwinism and mutation theory of de Vries.

UNIT – IV

Ecological succession: Causes, types and process, climax concept, theories on ecological succession - Synthetic theory of evolution**:** Basic concept with reference to Hardy-Weinberg equilibrium in populations and factors destablising such equilibrium (mutation, migration, genetic drift).

UNIT – V

Pollution biology and impact on human: Air pollution – source and effect of major air pollutants, greenhouse effect, ozone hole, physical and chemical control of air pollution; Water pollution – major causes and consequences with special reference to arsenic pollution in India; Noise pollution and its auditory and non-auditory effects. Stress physiology and physiological consequences - Other concepts of evolution**:** Goldschmidt's concept of micro- and macroevolution; Gould and Eldredge's 'punctuated equlibrium hypothesis'.

References:

1. Odum, Eugene Pleasants, Howard T. Odum, and Joan Andrews. *Fundamentals of ecology*. Vol. 3. Philadelphia: Saunders, 1971.
2. Soule, Michael E., and Bruce A. Wilcox. *Conservation biology. An evolutionary-ecological perspective*. Sinauer Associates, Inc., 1980.
3. Irvine Michael R. Rose. *Evolutionary Biology of Aging*. Oxford University press, 1991.

Course outcome:

Upon successful completion of the course, the student:

- **CO1.** Will be knowledgeable about the diversity, adaptations and biotechnological applications of microbes of extreme environment.
- **CO2:** Will have become acquainted with population ecology and evaluation concepts.
- **CO3:** Will have an overview of the to date developments in the field of environmental microbiology with special emphasis on the role of microbes in mitigating environmental pollution.

Cognetive Level

MGTNE 03: ECOLOGY AND EVOLUTIONARY BIOLOGY			
		Semester	III
Cognitive Level	K-3	Apply	30
	K-4	Analyze	30
	K-5	Evaluate	20
	K-6	Create	20

Mapping

MGTNE 03: ECOLOGY AND EVOLUTIONARY BIOLOGY															
CO/PO	**PO**					**PSO**									
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
CO1	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**1**	**2**	**3**	**1**	**1**	**3**	**2**	**2**
CO2	**3**	**1**	**2**	**3**	**3**	**1**	**3**	**1**	**2**	**3**	**1**	**1**	**3**	**2**	**2**
CO3	**2**	**2**	**3**	**1**	**3**	**3**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**2**	**2**

3 - Strongly Correlated; 2 - Moderately Correlated; 1 - Weakly Correlated

Course Code: MGTNE04 **PROTEOMICS** **Credits - 3**
Hours - 3

Course Objectives:

- To provide comprehensive knowledge on Proteomics.
- To provide the basics about proteins, metabolites and methods of Proteomics.
- To give adequate knowledge about the various modern Proteomics.

UNIT-I

Introduction: Proteomics. Branches of proteomics-Protein separation, Protein identification, Protein quantification, Protein sequence analysis, Structural proteomics, Interaction proteomics, Protein modification, and Cellular proteomics. Purification-Removal of interfering compounds, Salts, DNA, lipids, Protein solubilisation, Disulfide bonds, chaotropes, detergents, etc. Detection and quantitation-Chemical tagging, fluorescence, negative staining, Radio-labelling.

UNIT-II

Protein Expression system-transfection, transformation, transduction, induction, detection and purification of expressed transgenes. Protein/peptide chemical Synthesis-Biotinylated product, Antibody Production & Engineering. Protein Interactome-Methodology for detection, protein-protein interactions. Protein Arrays-protein polynucleotide, interactions with other Biomolecules, Signalling Complex, Liposome, reconstitution of membrane protein in lipid vesicles.

UNIT-III

Protein post separation analysis-X-ray crystallography and nuclear magnetic resonance - Tandem mass spectrometry combined with reverse phase chromatography or 2-D electrophoresis - Affinity chromatography – fluorescence resonance energy transfer (FRET), Surface Plasmon Resonance (SPR) - X-ray Tomography.

UNIT-IV

Proteome analysis-Algorithms for proteomics Protein expression profiling protein arrays Protein microarrays. Advantages and disadvantages of DNA and protein microarrays.

UNIT-V

Analysis of profile in normal and diseased conditions-Body Fluids, Lipid & Kidney, Blood diseases, Diabetes, Infectious Diseases, Stroke & Myocardial infarction, Nervous System, Alzheimer, Low abundance and hydrophobic proteins. High through put technique to identify the protein molecules in the sample.

References:

1. Liebler, D. C. Introduction to Proteomics: Tools for the New Biology. Humana Press, Totowa, NJ. 2002.
2. Westermeier, R. and T. Naven. Proteomics in Practice: A Laboratory Manual of Proteome Analysis. Weinheim: Wiley-VCH, 2002.
3. Twyman, R. M. Principles of proteomics. BIOS Scientific Publishers, New York. 2004.

COURSE OUTCOME:

On successful completion of this course, the students will

- **CO1.** Know the basic concepts of proteins and.
- **CO2.** Know the techniques to be adapted for protein-protein interaction.
- **CO3.** Learn the basics, principles, and application of techniques like Mass Spectrometer, 2D-NMR, X-ray diffraction, etc.
- **CO4.** Know the principle to produce the recombinant proteins.

Cognetive Level

MGTNE04: PROTEOMICS			
		Semester	IV
Cognitive Level	K-3	Apply	30
	K-4	Analyze	30
	K-5	Evaluate	20
	K-6	Create	20

Mapping

MGTNE04: PROTEOMICS															
CO/PO	**PO**					**PSO**									
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
CO1	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**1**	**2**	**3**	**1**	**1**	**3**	**2**	**2**
CO2	**3**	**3**	**2**	**3**	**3**	**1**	**3**	**1**	**2**	**3**	**1**	**1**	**3**	**2**	**2**
CO3	**3**	**2**	**3**	**1**	**3**	**3**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**2**	**2**
CO4	**3**	**3**	**3**	**2**	**3**	**3**	**1**	**1**	**2**	**3**	**1**	**1**	**3**	**2**	**2**

3 - Strongly Correlated; 2 - Moderately Correlated; 1 - Weakly Correlated