File Ref.No.58388/GA - IV - J3/2019/Admn

UNIVERSITY OF CALICUT

Abstract

General & Academic - CCSS PG Regulations 2019 - Scheme and Syllabus of M.Sc Microbiology programme w.e.f 2020 Admission onwards -Incorporating Outcome Based Education - Implemented - Subject to ratification of Academic Council - Orders Issued.

G & A - IV - J

U.O.No. 5711/2021/Admn Dated, Calicut University.P.O, 29.05.2021

Read:-1) U.O. No. 8994/2019/Admn, Dated 08.07.2019.
2) E-mail from the Chairperson, Board of Studies, Dated 25.05.2021.
3) Remarks of the Dean, Faculty of Science, Dated 26.05.2021.
4) Orders of the Vice Chancellor in the file of even no, Dated 28.05.2021.

ORDER

1. The scheme and syllabus of M.Sc Microbiology Programme under CCSS PG Regulations 2019 in the Teaching department of the University, w.e.f 2019 admission onwards has been implemented, vide paper read (1) above.
2. The Chairman, Board of Studies in Microbiology, vide paper read (2) above, has forwarded the Scheme and Syllabus of M.Sc Microbiology Programme incorporating Outcome Based Education(OBE) in the existing syllabus in accordance with CCSS PG Regulations 2019 for Teaching Department of the University, w.e.f 2020 admission, after circulating among the members of the board, as per Chapter 3(34) of Calicut University First Statute, 1976.
3. The Scheme and Syllabus of M.Sc Microbiology Programme,(CCSS-PG-2019) incorporating Outcome Based Education(OBE), has been approved by the Dean, Faculty of Science, vide paper read (3) above and by the Vice Chancellor, subject to ratification by the Academic Council, vide paper read (4) above.
4. The Scheme and syllabus of M.Sc Microbiology programme (CCSS) incorporating Outcome Based Education (OBE) in the existing syllabus, in tune with CCSS PG Regulations 2019, is therefore implemented with effect from 2020 Admission onwards under Teaching Department of the University, subject to ratification by the Academic Council.
5. Orders are issued accordingly.
6. U.O.No. 8994/2019/Admn Dated, 08.07.2019 stands modified to this extend. (Syllabus appended)

Arsad M

Assistant Registrar

To

The Head, Department of Life Sciences
Copy to: PS to VC/PA to PVC/ PA to Registrar/PA to CE/JCE I/JCE V/DoA/EX and EG Sections/GA I F/CHMK Library/Information Centres/SF/DF/FC

Forwarded / By Order

Section Officer

UNIVERSITY OF CALICUT

SCHEME AND SYLLABUS FOR M. Sc. MICROBIOLOGY (CCSS)

COURSE OFFERED BY

DEPARTMENT OF LIFE SCIENCES

2020 Admission onwards

PROGRAMME SPECIFIC OUTCOME

PSO1. Gain in-depth understanding of various aspects of microbiology pertaining to medical, agricultural, environmental and industrial applications.

PSO2. Familiarize with latest and advanced research tools and techniques pertaining to biology.

PSO3. Analysis of scientific issues across the spectrum of related disciplines.

PSO4. Acquire skills specific to microbiology and allied fields for converting information to knowledge through hypothesis, design, execution and analysis.

PSO5. Design experiments to prove scientific process and to synthesize product/ services for the benefit of community.

PSO6. Ability to retrieve biological information through data mining and data handling.

PSO7. Ability to present their work through written, oral, and visual presentations, including an original research proposal.

PSO8. Enable the students to improve the quality of human lives in relation to environment with the knowledge in microbiology.

PSO9. Capacity to work as a member of team upholding the essence of collaboration, cooperation, ethics and integrity.

PSO10. Ability to upgrade knowledge independently and act upon means of improvement for lifelong learning.

Regulations, Scheme and Syllabus for M. Sc degree course in Microbiology

Eligibility: A candidate seeking admission to M. Sc. Microbiology must have B. Sc in Microbiology or an equivalent degree of other universities/institutes.
Admission: 50% of marks (or corresponding CGPA) obtained in B. Sc Microbiology
Curriculum: Course of study consists of four semesters in two consecutive academic years.

PER WEEK WORK LOAD

Semester	Theory		Practical		Project/ Library/ Assignment/ Tutorial (Hours)	Credit for Project	Total		
	Credit	Hours (Creditx1)	Credit	Hours (Creditx3)			Credits	Hours	Marks
I	3x4=12	12	2x2=4	12	6	-	16	30	500
II	4x4=16	16	2x2=4	12	2	-	20	30	600
III	4x4=16 (2EL)	16	2x2=4	12	2	-	20	30	600
IV	2x4=8 (2 EL)	8	-	-	22	8	16	30	300
Total	**52**	**52**	**12**	**36**	**32**	**8**	**72**	**120**	**2000**

Internal Evaluation

Theory Paper	Marks	Practical Paper	Marks
a. Attendance /Classroom participation*	3	**a.** Lab skill/ Quality of Records	5
b. Seminar	5	**b.** Practical Test	10
c. Test Paper	8	**c.** Viva-voce	5
d. Viva-Voce / Field work	4	**d.** Total marks	**20**
e. Total marks	**20**		

*90% & above: 3 marks, 80 to 89%: 2 marks, 75 to 79%: 1 mark, below 75%: nil

Project Evaluation

Sl. No.	Particulars	Weightage (%)
1	Review of Literature and Formulation of the Research Problem/Objective	20
2	Methods and Description of the techniques used	15
3	Analysis and Discussion of results	30
4	Presentation of the report, organization, linguistics style, references etc.	15
5	Viva Voce examination based on the Project work/Dissertation	20
	Total	**100**

The valuation shall be jointly done by the supervisor of the project in the department and an External Expert from the approved panel.

No	Papers	Hr /week	Credit	Exams	Marks			
					Total	Ext▲	Int	Total
	Semester I		**16**					
1.	MBG 1C01. Microbial Physiology and Microbial Genetics	4	4	3	100	80	20	
2.	MBG 1C02. Microbial Enzymes and Secondary Metabolism	4	4	3	100	80	20	
3.	MBG 1C03. Molecular biology and RDNA Technology	4	4	3	100	80	20	500
4.	MBG 1C04. Practical I– (Microbial Physiology, Microbial Genetics & Enzymology)	6	2	5x2	100	80	20	
5.	MBG 1C05. Practical II (Molecular biology and RDNA Technology)	6	2	5x2	100	80	20	
	Semester II		**20**					
6.	MBG 2C06. Industrial Microbiology	4	4	3	100	80	20	
7.	MBG 2C07. Food and Agricultural Microbiology	4	4	3	100	80	20	
8.	MBG 2C08. Biostatistics and Bioinformatics	4	4	3	100	80	20	
9.	MBG 2C09. Immunology	4	4	3	100	80	20	
10.	MBG 2C10. Practical III (Food and Agricultural Microbiology)	6	2	5x2	100	80	20	600
11.	MBG 2C11. Practical IV (Bioinformatics)	6	2	5x2	100	80	20	
	Semester III Elective papers (EL) any two		**20**					
12.	MBG 3C12. Environmental Microbiology	4	4	3	100	80	20	
13.	MBG 3C13. Medical Microbiology and Emerging Diseases	4	4	3	100	80	20	
14.	MBG 3C14. Practical V (Industrial Microbiology & Environmental Microbiology)	6	2	5x2	100	80	20	
15.	MBG 3C15. Practical VI (Medical Microbiology and Immunology)	6	2	5x2	100	80	20	
16.	MBG 3E01. Bioinstrumentation	4	4	3	100	80	20	600
17.	MBG 3E02. Epidemiology and Public health	4	4	3	100	80	20	
18.	MBG 3E03. Biosafety, Bioethics and Intellectual Property Rights	4	4	3	100	80	20	
19.	MBG 3E04. Microbial Biotechnology	4	4	3	100	80	20	
	Semester IV Elective papers (EL) any two		**16**					
20.	MBG 4C16. Dissertation and Viva-voce	-	8	5	100	100	-	
21.	MBG 4E05. Antibiotic action and resistance	4	4	3	100	80	20	
22.	MBG 4E06. Microbial bioremediation technology	4	4	3	100	80	20	300
23.	MBG 4E07. Modern Trends in Diagnostic Microbiology and Nanobiotechnology	4	4	3	100	80	20	
24.	MBG 4E08. Microbial Pest control	4	4	3	100	80	20	
	Total		**72**		**2000**	**1620**	**380**	**2000**

▲ **External Examination.**

Practical examination - 80 Marks (Experiment –50, Viva -20 and Record -10) should be conducted by one external and one internal examiner.

* Dissertation –100 Marks (submitted work-75 marks, Defense – 25 marks.)

MBG 1C01. Microbial Physiology and Microbial Genetics

Course objectives: Learner acquires knowledge on the concepts of energy pathways, microbial growth, microbial cell quantifying methods and culture preservation strategies. Develop understanding on physical and chemical control of microbial growth, gene transfer, mutations and DNA repair mechanisms.

Course Outcome:

CO1	Describe microbial nutrient requirements, nutritional types and mechanism of nutrient uptake and transport.	K2
CO2	Explain the concepts of energy pathways, photosynthesis, energy storage and structural and physiological features of archaea.	K2
CO3	Summarize the factors affecting microbial growth.	K2
CO4	Compare the methods for physical and chemical control of microbial growth	K2
CO5	Discuss the application transfer of genetic information in prokaryotes.	K2
CO6	Explain Mutagenesis, compare DNA Repair Systems.	K3
CO7	Distinguish between the effectiveness of various microbial cell quantifying methods and culture preservation strategies.	K4

1. Common nutrient requirements; carbon, hydrogen, oxygen, electrons, nitrogen, phosphorus, sulfur and growth factors. Nutritional types of microorganisms. Substrate uptake and entry to the cell; chemotaxis, utilization of low and high molecular weight substrates, mechanism of nutrient uptake and transport, specific transport systems.
2. Main energy pathways; fermentation, respiration, pentose phosphate cycle. Photosynthesis. Fixation of CO_2 – Calvin cycle, C3-C4 pathway, Chemolithotropy. Energy storage; carbohydrate, lipid, polyphosphate and sulfur reserves. Spores, sporulation and associated production of usefuls. Structural and physiological features of archea.
3. The growth curve, measurement of microbial growth, the continuous and batch culture of microorganisms, microbial growth in natural environments, factors affecting microbial growth; Nutrition, Oxygen, Carbon Dioxide etc. Extremophiles and Microbial Stress Responses. Microbial cell quantifying methods; microscopic, physical and chemical methods. Culture preservation strategies. Physical and chemical Control of microbial growth.
4. Transfer of genetic information in prokaryotes, plasmids, plasmid replication, conjugation, f factor, transformation, transduction, recombination. Insertion Sequences and Transposable Elements; Conjugative Transposition, Integrons,
5. Mutagenesis; Spontaneous Mutations, The Nature of Mutational Events, Suppressor Mutations, Adaptive Mutations, DNA Repair Systems; Photoreactivation, Nucleotide Excision Repair, Transcription-Coupled Repair, Methyl-Directed Mismatch Repair, Very Short-Patch Mismatch

Repair, DNA Glycosylases and Base Excision Repair, Adaptive Response to Methylating and Ethylating Agents, Post-replication Daughter Strand Gap Repair, SOS-Inducible Repair.

References

1. Albert G. Moat., John W. Foster, Michael P. Spector. Microbial Physiology. 4th Edn. Wiley-Liss, Inc., New York. 2002
2. Ian W Dawes and Ian W Sutherland. Microbial physiology 2nd Edn. Basic microbiology series Vol 4. Blackwell Science.1992.
3. Joanne Willey & Linda Sherwood & Chris Woolverton. Prescott's Microbiology 9th Edn. McGraw-Hill Higher Education. 20013.
4. Eugene W. Nester & Martha T. Nester & Denise G. Anderson & C. Evans Roberts. Microbiology: A Human Perspective Sixth Edition. Mcgraw-Hill Higher Education. 2009

MBG 1C02. Microbial Enzymes and Secondary Metabolism

Course objectives: Learner acquires knowledge on the applications of microbial enzymes in various bioprocess industries including food processing, pharmaceuticals and development of secondary metabolites.

Course Outcome:

CO1	Discuss the applications of Microbial enzymes in food processing	K2
CO2	List and Illustrate various microbial enzymes and their applications in pharmaceutical industry.	K2
CO3	Explain types and practical applications microbial secondary metabolism.	K3

1. Applications of Microbial enzymes in food processing; Bacterial proteinases, Amylases Amyloglucosidases, Glucose Oxidases, Glucose dehydrogenases,glucose isomerases, beta galactosidases, Invertases, Pectic enzymes, Cellulases, Enzymic bioconversions e.g. starch and sugar conversion processes; High-Fructose Corn Syrup; Fermented foods and beverages; Food ingredients and additives prepared by fermentation and their purification; fermentation as a method of preparing and preserving foods; Microbes and their use in pickling, producing colours and flavours, alcoholic beverages and other products; Process wastes-whey, molasses, starch substrates and other food wastes for bio conversion to useful, Production of Bio ethanol, Bio hydrogen and bio pesticides
2. Microbial enzymes in Pharmaceuticals; Enzymes associated with the production of chiral intermediates for anticancer drugs, antiviral agents, 3-receptoragonists, anti hypertensive drugs, melatonin receptor agonists, anti cholesterol drugs, and anti-Alzheimer's drugs.
3. Microbial secondary metabolism; Introduction to secondary metabolism Introduction -General Aspects of Secondary Metabolism, Bacterial antibiotics, types, Microbial Siderophores, Peptide Antibiotics, Lantibiotics, Glycopeptide Antibiotics, Aminoglycosides and Sugar Components in Other Secondary Metabolites ,Cyclosporins. Bacterial toxins - Fungal toxins: - aflatoxins and ochratoxins-.; Biochemistry of methanogenesis. Biochemistry of Bioluminescence; Bioluminescent bacteria, Microbial metabolism of Xenobiotics. and steroid transformations.

References :

1. Michael Shuler and Fikret Kargi, Bioprocess Engineering: Basic Concepts, 2nd Edition, Prentice Hall, Englewood Cliffs, NJ, 2002.
2. Stanbury RF and Whitaker A., Principles of Fermentation Technology, Pergamon press, Oxford, 1997.
3. Baily JE and Ollis DF., Biochemical Engineering fundamentals, 2nd Edition, McGraw-Hill Book Co., New York, 1986.
4. Pauline Doran, Bioprocess engineering principles, 1 Edition, Academic Press, 1995.
5. Colin Ratledge, Bjorn Kristiansen, Basic Biotechnology, 2nd Edition, Cambridge. University Press, 2001.
6. Roger Harrison et al., Bioseparations Science and Engineering, Oxford University Press, 2003.

7. Jackson AT., Bioprocess Engineering in Biotechnology, Prentice Hall, Engelwood Cliffs, 1991.
8. Aiba S, Humphrey AE and Millis NF, Biochemical Engineering, 2nd Edition, University of Tokyo press, Tokyo, 1973
9. Economic microbiology Vol 5 edited by A H Rose 1980 ACADEMICPRESS
10. Biotechnology Second Edition Volume 7. Products of Secondary Metabolism Edited by H.-J. Rehm and G. Reeding cooperation with A. Piihler and P. Stadler
11. Enzyme and Microbial Technology 31 (2002) 804–826
12. Microbial/enzymatic synthesis of chiral intermediates for pharmaceuticals, Ramesh N. Patel* Process Research & Development, Bristol-Myers Squibb Pharmaceutical Research Institute, New Brunswick, NJ 08903, USA.
13. Signposts to Chiral Drugs, Organic Synthesis in Action Vitomir S unjic l Michael J. Parnham , Springer Basel AG 2011

MBG 1C03 Molecular Biology and RDNA technology

Course objectives: Learner develop the understanding of various aspects of gene expression and gene regulation. Advanced level understanding on tools and techniques in genetic engineering with its application is expected.

Course Outcome:

CO1	Explain the mechanisms behind the information flow from DNA to proteins and the multiple levels at which gene expression can be regulated.	K2
CO2	Compare gene expression and regulation in prokaryotes and eukaryotes	K2
CO3	Discus the molecular mechanisms underlying mutations and DNA damage and repair	K2
CO4	Explain the concept of oncogenes and tumour suppressor genes.	K2
CO5	Compare molecular tools and their applications in DNA modification, manipulation and cloning.	K2
CO6	Summarize the gene manipulation strategies. Discuss its application in pharmaceutical filed.	K2
CO7	Evaluate effectiveness of various the PCR Methods used in genetic engineering.	K3

1. Organization of Microbial and Eukaryotic Genomes. C-value paradox, Pseudogenes, Gene families, Gene clusters, Super-families. Watson & Crick model of DNA, DNA replication in prokaryotes & eukaryotes, reverse transcription. DNA damage & repair, DNA recombination, transposons.
2. Transcription: Transcription machinery of prokaryotes, various transcription enzymes and cofactors, initiation, elongation and termination, sigma factors, Transcription machinery of eukaryotes, various forms of RNA polymerase and cofactors, initiation, elongation and termination, promoters, enhancers, silencers, activators, effect of chromatin structure, regulation of transcription. Post-transcriptional processes: RNA processing, splicing,

capping and polyadenylation, rRNA and tRNA processing, RNA Editing; RNAi and miRNAs, Antisense RNA, Post-transcriptional gene regulation. Operon concept, -Lac & Trp operons.

3. Translation: The genetic code, Mechanisms of translation in prokaryotes and eukaryotes, in vitro translation systems, Regulation of translation, RNA instability, inhibitors of translation, stringent response in bacteria. Post-translational processing: Protein modification, folding, chaperones, transportation; The Signal Hypothesis, protein degradation.
4. Oncogenes and Cancer- Immortalization / transformation, metastasis, oncogenes and protooncogenes, Tumor suppressor genes. Transforming viruses, V-onc and C-onc genes, Ras pathway, Gene translocation, C-myc, Signal transduction, Src kinase, Tumor suppressors, RB and p53 protein, Apoptosis, DNA methylation and cancer, Molecular markers of tumor.
5. Polymerase Chain Reaction: Concept of PCR and various thermophilic enzymes used in PCR. Designing primers. Cloning PCR products. Variants of PCR, Ligation Chain Reaction, Overlap PCR, Rolling Circle Amplification Technology. Molecular markers in genome analysis: RFLP, RAPD, AFLP analysis. Probes- radiolabelled DNA/RNA probes, synthetic oligonucleotide probes.
6. Restriction endonucleases, Cloning vectors, cutting & joining DNA molecules, linkers, adaptors & homopolymer tailing. DNA libraries-genomic & cDNA libraries, Cloning strategies, Expression strategies, Screening strategies. DNA sequencing, nucleic acid microarrays, site directed mutagenesis & protein engineering, DNA introduction methods.
7. Pharmaceutical products of DNA technology: Human protein replacements – insulin, hGH and Factor VIII. Human therapies – TPA, interferon, antisense molecules. Vaccines – Hepatitis B, AIDS, and DNA vaccines. Transgenics and animal cloning: Creating transgenic animals and plants.

References

1. J.M. Berg, J.L. Tymoczko, L. Stryer. Biochemistry 5th edn. W.H. Freeman and Company, New York, USA, 2008.
2. Fred M. Ausubel; Roger Brent; Robert E. Kingston; David D. Moore; John A. Smith; Kevin Struhl. Current Protocols in Molecular Biology Edited by: John Wiley and Sons, Inc. 2007
3. I. Edward Alcamo. DNA Technology: The Awesome Skill. 2nd edn; Hardcourt Academic Press; 2001.
4. Benjamin Lewin, Gene IX. Jones and Bartlett Publishers, Sudbury, Massachusetts, 2007.
5. David P. Clarke. Molecular Biology 1st edn; Elsevier Academic Press; 2005.
6. R.F. Weaver. Molecular Biology. 4th edn, McGraw Hill. New York. USA, 2007.

7. B. Alberts, A. Johnson, J. Lewis, M. Raff, K. Roberts, P. Walter. Molecular Biology of the Cell. 5th edn, Garland Science, New York and London, 2007.
8. J.D. Watson, T.A. Baker, S.P. Bell, A. Gann, M. Levin, R. Losick. Molecular Biology of the Gene. 6thedn, Benjamin Cummings, San Francisco, USA, 2007.
9. Joseph Sambrook & David Russell. Molecular Cloning: A laboratory manual 3rd edn; CSHL press; 2001.
10. Desmond S. T. Nicholl. An Introduction to Genetic Engineering 3rd Edn. Cambridge University Press. 2008
11. Louis-Marie Houdebine. Animal Transgenesis and Cloning. John Wiley & Sons, Inc. 2003
12. Christopher Howe. Gene Cloning andManipulation 2nd Edn. Cambridge University Press. 2007
13. S.B. Primrose and R.M. Twyman. Principles of Gene Manipulation and Genomics. 7th Edn. Blackwell Publishing. 2006
14. HJ Reham and G. Reed Biotechnology (A multi-volume comprehensive treatise). Second Editon. Vol 2. Genetic fundamentals and genetic engineering. VCH publishing house mbH. 1993.
15. Gary Walsh. Pharmaceutical Biotechnology Concepts and Applications. John Wiley & Sons Ltd. 2007
16. K. Sambamurthy and Ashutosh Kar. Pharmaceutical Biotechnology. New Age International Pvt Ltd Publishers. 2006

MBG 1C04. Practical I (Microbial Physiology and Microbial Genetics, Enzymology)

Course objectives: Will gain proficiency in basic laboratory techniques in biochemistry, separation techniques, microbial enzyme studies.

Course Outcome:

CO1	Demonstrate the Anaerobic cultivation of bacteria and Effect of pH, temp, oxygen and salinity on bacterial growth	K4
CO2	Apply the knowledge in the preparation of solutions and buffers according to the neediness using molar, percentage etc.	K4
CO3	Analyse the Qualitative and Quantitate aspects of different bio active components Proteins, carbohydrates, citric acids etc.	K4
CO4	Demonstrate Enzyme kinetics and its assay using spectrophotometrically	K4
CO5	Perform isolation, Quantification, purification and separation of bioactive components using chromatographic techniques.	K4
CO6	Demonstrate various experiments which includes basic methods of physical biochemistry, biochemical analysis and separation methods.	K4
CO7	Demonstrate the detection of microbial population in soil and its enzyme production.	K4
CO8	Perform isolation of agriculturally important bacteria.	K4

1. Effect of pH, temp, oxygen and salinity on bacterial growth.
2. Bacterial growth curve under aerobic conditions.
3. Microbial culture preservation by glycerol stock and lyophilization.

4. Factors affecting enzyme activity: temperature, substrate concentration and pH using any stable enzyme and Kinetics of enzyme activity.
5. Anaerobic culturing by liquid paraffin overlay and pyrogallol.
6. Anaerobic enrichment of cellulose digesters.
7. Demonstration of Microbial Bioluminescence.
8. Enrichment cultivation of photosynthetic bacteria – Winogradsky column
9. Biofilm assay.
10. Demonstration of microbial enzyme activities –amylase, cellulase, pectinase etc.,
11. Demonstration of mutation in bacteria.
12. Isolation of antibiotic resistant bacterial population by gradient plate method.
13. Isolation of streptomycin resistant mutants by replica plating technique.
14. Demonstration of genetic recombination in bacteria by conjugation.
15. UV induced auxotrophic mutant production and their isolation
16. Bacterial transformation by $CaCl_2$ method
17. Bacteriophage Plaque Assay for Phage Titer
18. Preparation buffers.
19. Protein Estimation using Lowry's method
20. Determination of molar extinction coefficient of biological molecule
21. Estimation of % alcohol in a given sample by specific gravity bottle method.
22. Assay of trypsin
23. Estimation of ascorbic acid in plant matter
24. Citric acid estimation
25. SDS PAGE using protein Standards
26. Gel filtration chromatography
27. Dialysis of proteins
28. Paper chromatography
29. TLC
30. Column separation of plant pigments

MBG 1C05. Practical II (Molecular Biology and RDNA technology)

Course objectives: The learner acquires skills in the application of biochemistry, molecular biology and rDNA technology tools for gene manipulation.

Course Outcome:

CO1	Demonstrate and explain the stages of cell division	K4
CO2	Perform isolation and quantification of genetic materials via estimation, Isolation and visualization techniques.	K4
CO3	Perform the techniques gene transfer mechanism in Prokaryotes	K4
CO4	Demonstrate various applications of PCR based techniques.	K4
CO5	Test the knowledge in rDNA technology in transformation of host cells.	K4

1. Study of mitotic stages using onion root tip
2. Karyotype preparation
3. Preparation of Buffer stocks (TBE,TE and TAE)
4. Preparation of Equilibrated Phenol
5. Isolation of DNA and RNA
6. Estimation of DNA and RNA
7. Hyperchromic shift of DNA
8. Determination of purity of DNA
9. Isolation of RNA from plant sample
10. Agarose electrophoresis of DNA
11. Western Blot
12. Plasmid DNA extraction
13. PCR amplification of desired gene
14. Restriction digestion
15. Plasmid curing
16. RAPD analysis
17. Preparation of Competent Cell
18. Transformation of the Host Cells
19. Extraction of DNA from Agarose gel
20. Plating of the Bacteriophage
21. Preparation of stocks of bacteriophage lambda by plate lysis and elution

MBG 2C06. Industrial Microbiology

Course objectives: Student will be equipped with the knowledge to handle industrial microbes and basic instrumentation for the fermentation process. Students will be able to select industrially important microbes for economical production of antibiotic, organic acids, amino acids, etc.

Course Outcome:

CO1	Describe the concepts of fermentor design, and explain different types of bioreactors.	K2
CO2	Know the concepts of inoculum development and improve down stream processing	K2
CO3	List the basic nutrient requirements for industrial media, and select proper sterilization systems.	K3
CO4	Perform isolation microbes for industrial production of antibiotics, organic acids, amino acids, etc.	K3
CO5	Apply the selection and improvement concepts in bioprocesses.	K4
CO6	Will be able to analyse kinetics of fermentation process including mass transfer and apply the same for bioprocess improvement.	K4
CO7	Develope protocols for production of primary and secondary metabolites bypassing regulatory mechanisms for the over-production.	K5

1. Isolation and screening of industrially important microbes. Strain selection and improvement. Bioprocesses- concepts and design. Continuous and batch fermentations. Types of bioreactors. Bioreactor design and control. Submerged systems, Airlift reactor, CSTR, Algae bioreactor, Photobioreactor, Membrane bioreactor.
2. Kinetics of fermentation process. Transport phenomena in bioprocess such as mass transport coefficients for gases and liquids and oxygen transfer coefficients, heat transfer.
3. Industrial Media and the Nutrition of Industrial Organisms; Basic Nutrient Requirements, Criteria for the Choice of Raw Materials, Potential Sources of Components, Use of Plant Waste Materials and other natural resources. Sterilization systems.
4. Concepts of inoculum development. Monitoring and control of variables such as temperature, agitation, pressure and pH. Down stream processing – filtration, centrifugation, precipitation, salting out, crystallization and biphasic separation.
5. Industrial microbiological products as primary and secondary metabolites, regulation of overproduction of primary and secondary metabolites, bypassing of regulatory mechanisms for the over-production of primary and secondary metabolites.
6. Antibiotics: Screening of soil for antibiotic producers, Isolation and use of mutants. Production of antibiotics in bioreactors – penicillin, cephalosporins, aminoglycosides, and macrolides.
7. Production of Organic Acids- citric acid, Lactic acid and Industrial alcohol. Industrial fermentation of wine and beer. Production of Amino Acids by Fermentation- Semi-fermentation,

Enzymatic Process, Direct Fermentation. Production of amino acids by mutants and metabolically engineered organisms. Production of Ergot Alkaloids. Commercial microbial enzymes. Acetone - butanol fermentation. Importance and production of Single cell protein (SCP).

References

1. Michael J. Waites & Neil L. Morgan & John S. Rockey & Gary Higton. *Industrial Microbiology: An Introduction*. Wiley-Blackwell.2006
2. Nduka Okafor. *Modern Industrial Microbiology and Biotechnology*. Science Pub Inc 2007
3. Rajiv Dutta. *Fundamentals of Biochemical Engineering*. Ane Books India. 2008
4. Wulf Crueger, Anneliese Crueger. *Text book of Biotechnology*. Sinauer Associates Inc; 2 Sub edn. 1990
5. Richard H. Baltz, Julian E. Davies, Arnold L. Demain. *Manuel of Industrial microbiology and biotechnology*. Amer Society for Microbiology; 3 edn. 2010
6. G. Reed. *Prescott & Dunn's Industrial Microbiology*. CBS Publishers & Distributors. 2004
7. Peter Stanbury & Allan Whitaker & Stephen K. Hall. *Principles of Fermentation technology*. Oxford, U.K. : Pergamon, 1995.
8. Reham and G. Reed. *Biotechnology (A multi-volume comprehensive treatise).* Second Editon. VCH publishing house mbH. 2003.
9. Murray and Moo-Young. *Comprehensive biotechnology.* 2nd edn. Elsevier B.V. 2011.

MBG 2C07. Food and Agricultural Microbiology

Course objectives: Students get sufficient knowledge in understanding the relationship between food and microbes. Develop the skills in techniques used in food processing, preservation and understanding the different control measures in food spoilage. Understand various plant microbes interactions especially rhizosphere, phyllosphere and mycorrhizae and their applications especially the biofertilizers, biopesticides and their production techniques. The learner will be aware of the plant diseases caused by microorganisms and the defense strategies by the plants.

Course Outcome:

CO1	Classify the type of Microorganisms present in food able to cause contamination and what are the factors influence growths of microbes in foods.	K2
CO2	Discuss the defence mechanisms exerted by the plant in response to an infection	K2
CO3	Discuss the importance of microorganisms in food and factors affecting their growth in foods.	K2
CO4	Explain about food hygiene and regulatory practices	K2
CO5	Explain standards for assessing the quality of milk.	K2
CO6	Explain the various applications of microorganisms in agriculture to improve soil fertility as bio fertilizers and bio pesticides.	K2
CO7	Summarize spoilage of food, factors causing food spoilage and food preservation methods	K2
CO8	Elaborate different food borne infections	K3
CO9	Illustrate different plant diseases caused by microorganisms with emphasis to pathology and epidemiology.	K3

1. Microorganisms important in food microbiology and their source. Factors affecting microbial growth in food – intrinsic and extrinsic factors, Spoilage of meat fish, milk, vegetables, fruits and stored grains. Spoilage at low temperature.
2. Principles of food preservation. Food preservation by physical and chemical means: irradiation, drying, heat processing, chilling, freezing, high pressure and food preservatives. Class I and class II preservatives. Effect of self generated preservatives like organic acids. Modern techniques like high electronic field pulses, oscillating magnetic fields – pulses, intense light pulses and ultra high hydrostatic pressure.
3. Fermented dairy products- microbiology of yoghurt and cheese production. Fermented meat and vegetable products. Microbiology of malt beverages, wine and distilled liquors. Vinegar production. Idli, soyasauce and Indian pickle fermentations. Yeast role in bread making. Use of probiotics.
4. Food poisoning, intoxications like botulism and aflatoxins. Infections like *Salmonella, Staphylococcus, Listeria etc.* Foodborne Viruses, Spongiform Encephalopathies.
5. Methods for the Microbiological Examination of Foods; conventional and rapid detection methods. Controlling the Microbiological Quality of Foods; Codes for GMP. HACCP and FSO Systems for food safety. Food control agencies and their regulations.
6. Microbial interactions between plants rhizosphere -phyllosphere - mycorrhizae - symbiotic association in root nodules. Fixation of molecular nitrogen. Ti plasmid and its importance. Biofertilizers: VAM, *Rhizobium, Phosphobacteria Frankia, Azospirillum, Azotobacter* cyanobacteria. Microbial inoculants.
7. Factors predisposing plants to microbial infections. Mycoplasma and coconut wilt. Brief account of plant diseases caused by microbes- Paddy blast, wheat rust, tikka disease, whip smut of sugar cane, citrus canker, bean mosaic. Plant –pathogen interactions, plant defences, endophytic microbes. Plant disease control strategies. Biological insect control using microbial insecticides - *Bacillus thuringensis*, *Bacillus sphericus*, *Bacillus popilliae* against insects and *Pasteuria penetrans* against nematodes. Viruses – baculovirus – NPV, CPV. Fungi – *Entomophthora muscae* and *Beauveria bassiana*. Advantages and disadvantages of biopesticides, qualities of an ideal microbial pesticide. Factors affecting its efficiency. Mass production of bacterial, viral and fungal pesticides. Bioassays, quality control.

References

1. James M. Jay & Martin J. Loessner & David A. Golden. Modern Food Microbiology Seventh Edition. Springer. 2005
2. Bibek Ray & Arun K. Bhunia. Fundamental Food Microbiology. CRC Press. 1996

3. Martin R. Adams & Maurice O. Moss. Food Microbiology. Royal Society of Chemistry. 2008
4. Frazier, W.C. and Westhoff, D.C. Food Microbiology 4th Edn. TATA McGraw Hill Publishing company ltd., New Delhi. 1988
5. Jack E. Rechcigl and Nancy A. Rechcigl. Biological and Biotechnological Control of Insect Pests. CRC Press; 1 edn. 1999
6. G. Rangaswami, D. J. Bagyaraj, D.G. Bagyaraj. Agricultural Microbiology 2nd Edn. PHI Learning Pvt. Ltd.2004
7. Sushil Khetan. Microbial Pest Control. CRC Press. 2001
8. Nicolas Talbot. Plant-Pathogen Interactions. 2004
9. Amos Navon & K. R. S. Ascher. Bioassays of Entomopathogenic Microbes and Nematodes. CABI. 2000

MBG 2C08. Biostatistics and Bioinformatics

Course objectives: The Learner will be equipped with the tools to summarize the experimental data in diagrammatic and graphical way, to obtain descriptive statistics and make possible appropriate interpretations. Will be able to understand the properties of the most important bioinformatics databases, perform text- and sequence-based searches, analyze the results in light of molecular biology. Learner attain knowledge and awareness on the basic principles and concepts of Biology, Computer Science and Mathematics.

Course Outcome:

CO1	Describe statistical methods for collection, tabulation and representation of data, sampling and sample design	K2
CO2	Describe the concept behind drug designing with the application of bioinformatics tools.	K2
CO3	Plot diagrammatic representations of data and calculate central tendencies. (mean, median, mode, range, mean deviation and standard error)	K4
CO4	Perform correlation, regression and probability analysis of variables and calculate significance by t- test, Chi square test, goodness of fit and Analysis of variance	K4
CO5	Explain various biological data bases for sequence retrieval, analysis, sequence alignments, phylogeny and other applications	K4
CO6	Perform the method of molecular docking and their application	K4

1. Biostatistics: Methods for collecting data, tabulation and representation of data, sampling and sample design, types of classification, tabulation, diagrammatic representation line diagram, bar diagram, pie diagram, histogram, frequency polygon, frequency curves and cumulative frequency curves. Measures of central tendency: mean, median, mode, range, mean deviation and standard error. Correlation analysis and regression analysis, probability analysis of variables. Tests of significance: t- test, Chi square test and goodness of fit; Analysis of variance: one way classification and two way classification.
2. Introduction to Bioinformatics: Definition and History of Bioinformatics, Internet and Bioinformatics, Introduction to Data Mining, Applications of Data Mining to Bioinformatics Problems.

3. Introduction to biological databases, classification of biological databases, Genbank, Protein Data Bank, Swiss-prot etc. Biological data formats, data retrieval - Entrez and SRS. ExPASSY,
4. Introduction to Sequence alignment, Local and Global alignment concepts, Multiple sequence alignment –Progressive alignment. Database searches for homologous sequences –Fasta and Blast versions. Bioinformatics Softwares: Clustal, RasMol, EMBOSS, Genetic Analysis Software, Phylip. Evolutionary analysis: distances - clustering methods – rooted and unrooted tree representation.
5. Fragment assembly-Genome sequence assembly. Gene finding method, Gene prediction - Analysis and prediction of regulatory regions. Structure prediction and protein modelling.

References

1. Andreqas D. Baxevanis, B. F. Francis Ouellette. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins John Wiley and Sons, New York (1998).
2. Jonathan Pevsner. Bioinformatics and functional genomics.2edn, John Wiley & Sons, Inc. 2009
3. Bryan Bergeron. Bioinformatics computing. Prentice Hall PTR. 2002
4. David W. Mount. Bioinformatics - sequence and genome analysis.
5. Arthur M Lesk. Introduction to Bioinformatics. Oxford University Press. 2002
6. Jerrold H. Zar. Biostatistical Analysis.5th Edn. 2009

MBG 2C09. Immunology

Course objectives: Promotes critical thinking on the cellular ontogeny and organ involvement in immunity and the mechanisms involved in immune responses. Will develop good understanding on how the immune system functions and also develop the skill to diagnose various diseases by immunological assays. The students will be able to describe the roles of the immune system in both maintaining health and contributing to disease. Acquaint knowledge immune mediated conditions like hypersensitivity, autoimmunity and immune deficiency diseases.

Course Outcome:

CO1	Describe the cells, organs, molecules, mediators, receptors associated with immune responses.	K2
CO2	Explain the importance and mechanisms of MHC, T- cell /B cell activation and auto immune diseases.	K2
CO3	Illustrate the development of different immune responses in a host.	K3
CO4	Explain the mechanisms of Hybridoma technology, antigen antibody reactions and Complement system	K3
CO5	Categorize different immune associated disease conditions like hypersensitivity, autoimmunity, graft rejection and tumor development based on mechanism.	K3
CO6	Classify the immunoglobulins with a detailed understanding of their diversity generation	K4

1. Immune response. Cells involved in the immune system-Myeloid and Lymphoid lineage. Antigen and Antibody. Generation of antibody diversity-genetic events (organisation and rearrangement)

in the synthesis of kappa, Lamda and Heavy chainss. Allelic exclusion, Class or isotype switching. Applications of Antigen and Antibody reactions in immunodiagnosis. Monoclonal antibodies and Hybridoma techniques.

2. Biology of B-lymphocyte. Various stages in the maturation and development of B-lymphocyte. B-cell surface molecules – Antigen binding molecule (Ig), Signal transduction molecules, Coreceptor and Co-stimulatory molecules, molecules involved in antigen presentation and isotype switching etc. Intracellular signalling and activation in B cells.
3. Biology of T-lymphocyte. T cell differentiation in the thymus and outside. Alpha-beta T cells. Surface molecules - T-cell receptor and T cell receptor complex, CD4 and CD8, costimulatory and adhesion molecule.
4. Major Histocompatability Complex- Genetic organisation of the MHC Class I and Class II genes and the structure of these molecules. Codominant expression, Coordinate expression and genetic polymorphism of MHC genes. The other important genes present in the HLA region. Processing and presentation of exogenous and endogenous antigens and generation of MHC-peptide complexes.
5. Activation of T and Bcells. Activation of CD4+ T cells and their functions. Major subsets of CD4+ T cells. Major cytokines (TNF, IFN, IL-1, IL-2, IL-4, IL-6, IL-10, IL-17 etc) and their role in immune regulation. Activation of CD8+ cytotoxic Tcell and killing of target cells. B cell activation and cellular mechanisms in the antibody production. T-B cell cooperation in antibody production, B cell activation in the absence of T-cell help.
6. Brief account of common autoimmune diseases, hypersensitivity reactions (types 1-IV), graft rejection and GVH reaction, immune response to tumors and common immunodefeciency diseases.

References

1. Immunology A short course, Richard Coico, Geoffrey Sunshine. 2015.WILEY Blackwell.7th edition.
2. Immunology A short course, Eli Benjamini, geoffrey Sunshine and Sydney Leskowitz.1991 Wiley-Liss.
3. Immunology a short course-Eli Benjamini, Geoffrey Sunshine, Sydney Leskowitz-Wiley Liss Publications.
4. Roitt's Essential Immunology by Delves PJ, Martin SJ, Burton DR, Roitt IM; 11th edition. Blackwell Publishing/Oxford Univ. Press; 2006.e
5. Kuby Immunology by Kindt TJ, Goldsby RA, Osborne BA, Kuby J: 6th edition. New York. WH Freeman; 2006.
6. Immunobiology: The immune system in health and disease by Janeway CA,Travers P,Walport M, Shlomchik MJ: 6th edition. New York. Garland Science Publishing; 2005.
7. Medical Microbiology and Immunology by Levinson W, Jawetz E: Lange publication; 2001.

8. Essentials of Clinical Immunology, 5th Edition. Helen Chapel, Mansel Haeney, Siraj Misbah, Neil Snowden. May 2006, Wiley-Blackwell.
9. Fundamental immunology. Seventh Edition. William E. Paul. 2012
10. Ananthanarayan and Paniker's Textbook of Microbiology. C.K. Jayaram Paniker, R. Ananthanarayan. Universities Press (India) Pvt. Ltd., Orient Longman Limited. 2009.

MBG 2C10. Practical III (Food and Agricultural Microbiology)

Course objectives: Learner develope skills in various enumeration techniques for microbes important in food microbiology. Also becomes proficient in development of microbial inoculants and detection of enzyme producers.

Course Outcome:

CO1	Perform study of microflora in various food items	K4
CO2	Analyse the microbiological quality of milk using various methods.	K4
CO3	Demonstrate the isolation and preparation of bioinoculants	K4
CO4	Perform isolation and detection of enzyme producers	K4

1. Study of microflora in idli, soya-sauce, chilli sauce, palm toddy
2. Aerobic mesophilic count of fish samples and milk.
3. Direct microscopic count of milk.
4. Methylene blue reductase test
5. Isolation of constituent flora of fermented milk.
6. Isolation of rhizobium.
7. Isolation of azotobacter.
8. Isolation of phosphate solubilizing organisms
9. Preparation of bioinoculants – phosphate solubilizers, mycoinsecticides (Trichoderma) and cell count determination on time scale
10. Testing of nodulation ability by rhizobia
11. Preparation of bioinoculants – phosphate solubilizers and N_2 fixers -and cell count determination on time scale
12. Study of probiotic properties of Lactobacilli (Cholesterol Reduction and Bile Salt Hydrolase Activity)
13. Cultivation of Psychrotrophic Microorganisms
14. Isolation of lipolytic microorganisms from butter
15. Detection and Quantification of Starch and Cellulose in Milk
16. Detection of Added Urea and Sodium chloride in Milk
17. Detection of Presence of Foreign Fat in Milk
18. Detection of Nitrates (Pond Water) in Milk
19. Test for Presence of Skimmed milk Powder in Natural milk (Cow, buffalo, goat, sheep)

20. Test for Presence of Formalin in Milk
21. Turbidity Test for Checking Efficiency of Sterilization in Liquid Milk

References

1. John F. T. Spencer & Alicia L. Ragout de Spencer. Food Microbiology Protocols. Humana Press.2001
2. Diane Roberts (ph. D.) & Diane Roberts & Melody Greenwood. Practical Food Microbiology. Wiley. 2003

MBG 2C11. Practical IV (Bioinformatics)

Course objectives: Develop skills in datamining, sequence analysis, use of various bioinformatics tools to relate structure, sequence and function. Will be able to analyse the human genome, identification of targets for drug discovery, development of new algorithms and analysis methods, the study of structural and functional relationships, and molecular evolution.

Course Outcome:

CO1	Explain the features of National Centre for Biotechnology Information (NCBI)	K3
CO2	Demonstrate proficiency in bioinformatics methods including accessing the major public sequence databases, use of the different computational tools to find sequences, analysis of protein and nucleic acid sequences by various software packages	K4
CO3	Use existing software effectively to extract information from large databases and to use this information in computer modeling.	K4
CO4	Preform sequence comparison using various alignment tools	K4
CO5	Create protein structures with modelling tools.	K4
CO6	Prediction of Gene structure, gene function and ORF position.	K4
CO7	Perform structural, functional and phylogenetic analysis using various softwares.	K4

1. Data retrieval from Swiss-Prot, GenBank and PDB, Pubmed, GEO
2. Pairwise Sequence Alignment using BLAST and FASTA
3. Multiple Sequence Alignment with CLUSTAL W
4. Gene structure and function prediction (using GenScan, GeneMark)
5. Protein sequence analysis (ExPASy proteomics tools)
6. Finding ORF of a Given Sequence
7. Retrieving Motif Information of a Protein Using Prosite
8. Retrieving Gene Information from TAIR database
9. Primer Designing
10. Global alignment of two sequences
11. Local Alignment of Sequences
12. Phylogenetic Analysis using PHYLIP
13. Calculating the Distance between the Ligand and a Particular Amino acid
14. Finding the Active Site Pockets of a given Protein Molecule

15. Primary Structure Analysis of a Protein Using ProtParam
16. Secondary structure analysis of a protein using SOPMA
17. Surface Analysis of a Protein Using CASTp
18. Retrieving details of a drug molecule
19. Protein/Nucleotide Sequence Analysis using EMBOSS
20. Molecular Visualization tools
21. Homology modeling using SPDBV/Modeller
22. Model structure refinement using SPDBV
23. Model validation using What Check and Pro Check
24. Docking using AUTODOCK/ HEX

MBG 3C12. Environmental Microbiology

Course objectives: Learner get basic idea on microflora of soil, air and water ecosystem and the role of microorganisms in the formation of biofilms. The environmental monitoring using microbes and application of microbes in environmental engineering is addressed.

Course Outcome:

CO1	Elaborate the role of microbes in soil, water and air	K2
CO2	Explain biogeochemical cycles and their importance in an ecosystem	K2
CO3	Summarise the methods of air quantitation, air sanitation, sewage treatment and water purification.	K2
CO4	Discuss the applications of microbes in various fields of environmental monitoring like bioremediation, GMOS and waste treatment methods etc.	K3

1. Soil microflora, microbial interactions -competition, succession, symbiosis, parasitism, synergism and antagonism. Geocycles of C, N, S, P. iron and sulphur oxidation. N_2 fixation. Mycorrhiza, rhizosphere and phylloplane microflora. Effects of Genetically Modified Plants on Soil Microorganisms.
2. Air microbiology: Source of microbes and their quantitation techniques. Factors affecting the extent and type of air microflora. Early warning of animal, human and plant diseases by air monitoring. Brief account of air born transmission of microbes – viruses, bacteria and fungi – their preventive measures.
3. Water and Wastewater; Physical Parameters, Chemical Parameters, Biological Characteristics, Disposal of Wastewater, Treatment of Wastewater, Wastewater Biology and indicator organisms, Secondary Treatment, Anaerobic Treatment, Effluent Disposal, Sludge Treatment and BOD concepts. Bacteriological analysis of drinking water. New Molecular Methods for Detection of Waterborne Pathogens.
4. Autoaggregation of Microorganisms: Flocs and Biofilms, Development of Biofilms, Role of organisms in Flocs and Biofilms. Monitoring of Environmental Processes with Biosensors and Biological indicators, Treatment of tannery and slaughter house waste. Solid waste management and land filling. Biodeterioration; paper, leather, wood, textiles etc., metal corrosion- mode of deterioration- organisms involved – its disadvantages – mode of prevention. Environmental impact of GMOs.

References

1. Hans-Jürgen Rehm & Gerald Reed & Josef Winter. Biotechnology, 2E, Vol.11A, Environmental Processes I. VCH. 1999.
2. Ralph Mitchell & Ji-Dong Gu. Environmental Microbiology. Wiley-Blackwell. 2009
3. Eugene L. Madsen. Environmental Microbiology: From Genomes to Biogeochemistry. Wiley-Blackwell. 2008.
4. Myung-Bo Kim. Progress in Environmental Microbiology. Nova Biomedical Books. 2008

MBG 3C13. Medical Microbiology and Emerging Diseases.

Course objectives: Get acquainted with the molecular basis of pathogenesis and virulence of different pathogens. Be sensitized to the social impact of the most dreadful diseases. Will acquire knowledge on various emerging microbial infections and biological warfare.

Course Outcome:

CO1	Describe the morphology, pathogenicity, epidemiology, laboratory diagnosis and treatment of important human bacterial and viral pathogens.	K2
CO2	Explain various determinants of microbial pathogenicity.	K2
CO3	Describe the factors that contribute to emergence and reemergence of infectious diseases.	K3
CO4	List and summarise the pathogenicity, epidemiology, laboratory diagnosis and treatment of the newly emerging and re-emerging diseases.	K3
CO5	Discuss the characteristics and biological weapons. Debate on possible bioterrorism threats.	K4

1. Determinants of Microbial Pathogenesity: Microbial adherence to cell surfaces- Microbial adhesins: Pili or fimbriae, non-pilus adhesins, biofilm, surface proteins like curli; Host cell receptors: Sugars like sialic acid, CR2 receptor on B- lymphocyte for EBV, T-cell CD4 for HIV etc.; Adhesin-receptor interactions: proteolytic processing, Canyon hypothesis, conformational changes of adhesins etc.; Invasion- invasive enzymes: hyaluronidase, collagenase, coagulase, IgA proteases; Antiphagocytic factors: capsule, cell wall proteins (protein A of Staph, M protein of Strep etc) and cytotoxins (leukocidins, hemolysins); Intracellular survival- Toxins: Exotoxins- action mechanism of exotoxins from gram-positive bacteria: inhibition of protein synthesis by ADP-ribosylation of EF-2 (diphtheria toxin), preventing release of the inhibitory neurotransmitter glycine (tetanus toxin), blocking the release of acetylcholine (botulinum toxin), acting as superantigens (TSST, enterotoxin) produced S. aureus, pore formation by Panton-Valentine (PV) leukocidin produced by MRSA etc. secretion systems - type III secretion system; Endotoxins: septic shock.
2. Epidemiology, pathogenicity and treatment of some common microbial diseases: H.influenzae, C.diphtheriae, Cl. tetani, E.coli, Epstein Barr Virus, Cryptococcus neoformans, candida albicans, Toxoplasma.
3. Factors that contribute to the emergence and re-emergence of the infectious diseases: impact of urbanisation, international travel and trade, role of global warming... etc. Mechanism of emergence of new pathogens-microbial change and adaptation, horizontal gene transfer(HGT), pathogenicity islands, role of intgerons.
4. Newly emerging and re-emerging diseases: Respiratory diseases: SARS, Avian flu, MDR-M.tuberculosis; Diarreal diseases: *V.cholerae* 0:139, Enterohoemorrhagic E.coli(EHEC); Vector borne diseases: Dengue hoemorrhagic fever, Chikungunya. Other emerging diseases: Lyme

diseases, Japaneese encephalitis, Hand, Foot, Mouth Disease, Ebola, Aids. Diseases caused by *Helicobacter pylori*, prions, opportunistic fungal pathogens: *Aspergillus fumigatus, Candida sps.*

5. Microbial warfare: Characteristics of biological agents that could be used as bioterrorist agents. Factors that makes microbial agents attractive in war, disadvantages of microbial weapons, Microbial agents with bioterrorism potential - *B.anthracis, yersinia pestis* and Variola.

References

1. Medical Microbiology. Eighteenth edition. David Greenwood Mike Barer, Richard Slack Will Irving. Elsevier 2012.
2. Essentials of Medical Microbiology, Apurba Sankar Sastry and Sandhya Bhat, K., jaypee 2016, New delhi.
3. Principles and practice of infectious diseases , 7th edition, Gerald L. Mendell, John E Bennett, Raphel Dolins. Elsevier 2010, Philadelphia.
4. Ananthanarayan and Paniker's Textbook of Microbiology. C.K. Jayaram Paniker, R. Ananthanarayan. Universities Press (India) Pvt. Ltd., Orient Longman Limited. 2009
5. Medical Microbiology. Thomas Jones Mackie, J. G. Collee, James Elvins McCartney. Churchill Livingstone, 1989
6. Bailey & Scott's Diagnostic Microbiology, 12e. Betty A. Forbes, Daniel F. Sahm, Alice S. Weissfeld.2007
7. Diagnostic Microbiology-V- Edition. Elmer .Keneman,Stephen D.Allen, William M. Janda.
8. Manual of clinical microbiology-8th Edition.Volume –1.Patrick R Murray, Ellen JO Baron, James .H. Jorgensen.
9. Principles and Practice of Clinical Bacteriology. Stephen Gillespie & Peter M. Hawkey. Wiley. 2005
10. Jawetz Melnick&Adelbergs Medical Microbiology 26/E. Geo. Brooks, Karen C. Carroll, Janet Butel, Stephen Morse. 2012.
11. Medical Microbiology and Immunology by Levinson W, Jawetz E: Lange publication; 2001.
12. Medical Microbiology. F. H. Kayser, K. A. Bienz, J. Eckert, R. M. Zinkernagel.Thieme; 1 edition 2004.

MBG 3C14. Practical V (Industrial Microbiology & Environmental Microbiology)

Course objectives: Learner acquire skills in applying industrial microbiology principles for the production of useful metabolites, their downstream processing and analysis. Also perform screening of environmental samples for microbial analysis and quantification.

Course Outcome:

CO1	Acquire knowledge on industrial production of economically important products using microorganisms.	K3
CO2	Perform screening of microbes from the environmental samples.	K4
CO3	Acquire theoretical and technical knowledge on microbial production of antibiotics and extracellular enzymes.	K4
CO4	Analyze the methods for effective recovery and purification of fermented products.	K4
CO5	Use microbiological techniques for the production of various industrial products including alcohol, wine, citric acid, lipase, penicillin etc.	K4
	Perform media optimization, downstream processing, bioassays and various enzyme assays.	K4

1. Demonstration of microbial succession
2. Isolation of antibiotic producers from soil
3. Isolation of extracellular enzyme producers - cellulase, protease, lipase and phosphatase
4. Bioassay of penicillin using Bacillus subtilis
5. Lipase production test
6. Solid state fermentation
7. Enzyme/cell immobilization
8. Cell disruption techniques
9. Downstream processing - Salting out
10. Alcohol fermentation
11. Production of wine from grapes
12. Citric acid production.
13. Production of penicillin
14. Media optimization using RSM
15. Use of biofilms in sewage treatment
16. Demonstration of bio- gas production from cow dung
17. Determination of dissolved oxygen (DO)
18. Determination of chemical oxygen demand (COD)
19. Determination of BOD of water
20. Water portability testing using indicator organisms.

21. Detection, isolation and characterization of PHB granules in bacteria
22. Determination of Thermal death point (TDP) and Thermal death time (TDT) of microorganisms.
23. Biosurfactant determination by emulsification activity, microplate assay, Drop collapse test, oil displacement test, hemolysis, penetration assay and BATH assay.

MBG 3C15. Practical VI (Medical microbiology and Immunology)

Course objectives: The diagnostic methods in microbiology and immunology are practiced by the learner in this course. The course will also provide a hands-on expertise in identification of pathogenic bacteria from a clinical sample, sensitivity profiling of the isolate

Course Outcome:

CO1	Determine the efficacy of antimicrobial compounds	K3
CO2	Cultivate pathogenic bacteria in selective/ differential media	K4
CO3	Demonstrate skills in isolation and identification of various pathogenic microorganisms.	K4
CO4	Perform immunological tests for diagnosis of antigen/antibody	K4
CO5	Perform basic haematological analysis including Blood grouping, TC/DC and ESR determination.	K4

1. To study cultural characteristics of pathogenic bacteria on following selective/differential media: TCBS agar; Hektoen Enteric agar; XLD agar; Endo agar; Salmonella -Shigella agar; Deoxycholate citrate agar.
2. Antimicrobial sensitivity tests - Kirby-Bauer Method, Stoke's Method, Agar Dilution Method, Broth Dilution Method, E-Test
3. Estimation of antimicrobial activity using standard guidelines (NCCLS/CLSA)
4. Detection of beta lactamase production
5. Detection of antifungal activity
6. Identification of the common bacterial pathogens using biochemical tests.
7. Normal microflora of skin, oral cavity and throat.
8. ELISA
9. Precipitation reactions of antigen-antibody; Ouchterlony double immunodiffusion, immunoelectrophoresis, VDRL
10. Agglutination techniques: Latex Agglutination, WIDAL
11. Blood group determination
12. Blood cell count – TC and DC
13. ESR determination
14. Preparation of primary cell line

15. Rapid immune diagnostic procedure – RPR
16. Agglutination test - RF, CRP &ASLO
17. Mycological methods: Macroscopic observation, Microscopic observation, Culture, KOH preparation of skin/nail scrapings for fungi.
18. Identification of Mucor, Rhizhopus, Aspergillus, Penicillium, Candida – SDA/corn meal agar-slide culture methods - Germ tube method - sugar assimilation/fermentation tests.

MBG 3E01. Bioinstrumentation

Course objectives: Develop basic understanding on Microscopy, separation techniques, spectroscopic, chromatographic techniques, electrophoresis and nucleic acid amplification techniques.

Course Outcome:

CO1	Describe the principles and applications of various separation and characterization techniques from basic chromatography level to advanced MALDI TOF, NMR level.	K2
CO2	Compare the PCR types and applications	K2
CO4	Illustrate the advances in microscopy with their application in cell and molecular level identification, characterization and sorting.	K2
CO3	Appraise various methods for nucleic acid and protein-based characterization of cells and compounds	K4

1. Absorption and Transmittance, Lambert-Beer's law, Colorimetry, Single beam and double beam spectrophotometers, Calibration and standardization, Centrifugation -Principles, types, applications. Ultracentrifugation. Dialysis, Ultrafiltration.
2. Chromatographic techniques- TLC, Paper, Gas, Column, Ion exchange, HPLC, GC-MS, Affinity chromatography. Gel electrophoresis- Principles and instrumentation, Isoelectric focusing, Two dimensional gel electrophoresis, 2D-DIGE, Pulse field gel electrophoresis, Gel documentation.
3. X-ray diffraction and molecular structure, Mass spectrometry, Ionization and fragmentation, Basics of LC/MS, Tandem mass spectrometry, MALDI-TOF, Nuclear magnetic resonance spectrometry.
4. Nucleic acid amplification methods, PCR-Types- Nested PCR, Real time PCR; RFLP; RAPD and AFLP analysis; Blotting techniques, Protein and nucleic acid sequencing; Nucleic acid microarrays.
5. Phase contrast and confocal microscopy, Principles of SEM & TEM, Fluorescence microscopy, Atomic force microscopy. EIA, ELISA, Immunofluorescence, RIA, Chemiluminescense, Blotting Technique (Western, Southern, Northern), Flow cytometric assays.

References

1. Vasantha pattabhi and N. Gautham. Biophysics. Kluwer academic publishers. 2002
2. Bengt Nölting. Methods in modern biophysics. 2nd edn.springer-verlag berlin heidelberg. 2006
3. David Sheehan. Physical biochemistry: principles and applications 2nd edn. john wiley & sons ltd. 2009
4. Thomas Jue. Biomedical applications of biophysics. Vol 3. Humana press. 2010
5. Rodney F. Boyer. Modern experimental biochemistry. 3rd edn. 2000
6. Keith Wilson and John Walker. Principles and techniques of biochemistry and molecular biology 7th edn. Cambridge university press. 2010

MBG 3E02. Epidemiology and Public Health

Course objectives: Develop basic understanding on Microscopy, separation techniques, spectroscopic, chromatographic techniques, electrophoresis and nucleic acid amplification techniques.

Course Outcome:

CO1	Define the concepts of health education, health indicators, and epidemiology.	K1
CO2	Discuss the importance of emerging and re-emerging diseases from a public health point of view.	K2
CO3	Demonstrate the steps in outbreak investigation through recent examples.	K3
CO4	Distinguish the various approaches in epidemiology and their advantages.	K4

1. Health- definition-Determinants &Indicators of health - Health promotion-Health education in health promotion
2. Epidemiology definition- Define rate ,ratio ,proportion (measures of disease frequency) - Measures of Morbidity-Prevalence &Incidence-Mortality Measures -Common measures of fertility Classification of epidemiologic methods (with help of flow chart/line diagram)-Descriptive epidemiology – Steps in descriptive studies-Use of epidemic curve- Different types of disease fluctuations-student -Role of spot maps-Uses of descriptive studies-Types of analytical studies Differences between Case control study &Cohort study-Concept of Absolute risk-Relative risk –Attributable risk –Odd's Ratio-Experimental epidemiology-Design of a Randomised controlled trial-Blinding-Randomisation – Phases in clinical trials-Steps in Research
3. Define the term surveillance of disease- Uses-Enlist the basic steps in surveillance-essentialqualities of well-conducted surveillance system.
4. Epidemic; Steps in an outbreak investigation, Collection of samples in outbreaks.
5. Environment; Common environmental health problems, Emerging and reemerging diseases of public health importance. Infection control measures in health.

References

1. Centers for disease control and prevention. *Principles of epidemiology in public health practice*. An introduction to applied epidemiology and biostatistics. 3rd edn. U.s. Department of health and human services.
2. K.park - *Park's textbook of preventive and social medicine*. Banarsidas bhanot publishers. 20th edn (2009).
3. Richard Farmer. Ross Lawrenson. *Lecture Notes on Epidemiology and Public HealthMedicine*. 5th Edn. (2004)
4. Susan Carr, Nigel Unwin and Tanja Pless-Mulloli. *An Introduction to Public Health and Epidemiology* Second Edition. Open University Press, McGraw-Hill Education (2007)
5. R. Beaglehole., R. Bonita., T. Kjellstrom. *Basic epidemiology*. WHO (1993)
6. Ross c. Brownson., diana b. Petitti. *Applied epidemiology. Theory to practice*. (eds) Oxford university press (1998)
7. Alexander Krämer & Mirjam Kretzschmar & Klaus Krickeberg. *Modern Infectious Disease. Epidemiology: Concepts, Methods, Mathematical Models, and Public Health*. Springer. 2009

MBG 3E03. Biosafety, Bioethics and Intellectual Property Rights

Course objectives: To incorporate fundamental ethical and safety principles that is critical for various scientific disciplines and procedures, as well as the defense of intellectual property and associated rights. To grasp the importance of a well-balanced integration of science and social knowledge in long-term growth.

Course Outcome:

CO1	Recognize the role of IPR in protecting the intellectual properties with a special emphasis to biotechnology based inventions.	K1
CO2	Interpret the fundamentals of bio-safety and bioethics, as well as their effect on all biological sciences and human life quality	K2
CO3	Discuss the bio-safety regulations pertaining to GMOs, food safety and environmental sustainability.	K2
CO4	Discuss the issues related to IPR in India and also with patenting of microorganisms and transfer of technology.	K2

1. Definition of bioethics. The principles of bioethics: autonomy, human rights, beneficence, privacy, justice, equity etc. Applications of bioethics. Bioethics in laboratory. Experiments on animals. ELSI of Human genome project. Ethical issues of Prenatal diagnosis and genetic manipulations. Genetic studies on ethnic races. Reproductive Cloning, Therapeutic Cloning and Experiments with Human Cells, Genetic Testing and Concerns about Eugenics, GM Foods and the Rise of Environmental Movements Owning Genes, Genomes, and Living Beings.
2. Biosafety guidelines and regulations, Risk assessment, Laboratory safety, Controlling the exposure to hazardous substances. Release of GMOs to environment. Biotechnology and food safety: The GM-food debate and biosafety assessment procedures for biotech foods & related products, including transgenic food crops. Ecological safety assessment of recombinant organisms and transgenic crops.

3. *Intellectual Property Rights:* Copyrights, Trade Mark, Design Rights, Geographical indications and Traditional Knowledge. Patent Application procedure, Drafting of a Patent Specification. Objectives, Rights, Assignments of patents and Defences in case of Infringement.
4. Protection of biotechnological inventions. patentable subjects and protection in biotechnology. Strasbourg convention and UPOV convention. Plant variety protection in India. Experimental Use Exemption. The patentability of microorganisms, transfer of technology. Patentability of vectors. Patented research tools - Recombinant DNA, PCR, Taq Polymerase, Protein and DNA Sequencing Instruments.

References

1. Ben Mepham. Bioethics: An Introduction for the Biosciences. 2nd Edn.Oxford university Press. 2008
2. Sathish M.K. Bioethics and Biosafety. International Publishing house Ltd. New Delhi, 2011.
3. Alexander Poltorak and Paul Lerner. ESSENTIALS of Intellectual Property. JOHN WILEY & SONS, INC.2002.
4. Stephen G. Post. Encyclopedia Of Bioethics. 3rd Edn. Macmillan Reference USA. 2004
5. Darryl R.J Macer. Biotechnology - A comprehensive treatise (Vol. 12). Legal economic and ethical dimensions VCH. Eds, H-J. REHM and G. REED.
6. Sree Krishna. V. Bioethics and Biosafety in Biotechnology. New Age International.2007

MBG 3E04. Microbial Biotechnology

Course objectives: The course will impart knowledge on various technologies used in the field of Biotechnology for microbial based product development and their application.

Course Outcome:

CO1	Discuss the use of different technologies in developing microbial products with potential application in diagnosis, industrial, bio-engineering and bio-synthesis fields.	K2
CO2	Describe the advanced methods used in water quality analysis, monoclonal antibody production, recombinant vaccines, GMOs, bio-sensors, and bio-fuels.	K2
CO3	Explain the methods and applications in Protein Engineering, Pathway Engineering and Metabolic engineering	K2
CO4	Illustrate the advances drug discovery through synthetic biology approach.	K2
CO5	Compare the concepts in enzyme and process engineering as a novel strategy in biodegradation	K2

1. Hybridoma technology for monoclonal antibodies, recombinant vaccines, Vaccine farming, Gene Therapy.
2. Immobilization: Immobilization of cells and enzymes. Methods of immobilization – adsorption, covalent linking, entrapment, encapsulation. Microcarriers and holofibers. Advantages and disadvantages of immobilized systems. Emerging microbilological methods for water quality analysis - Fast Detections using Chromogenic Substances, Application of Monoclonal and Polyclonal Antibodies, IMS/culture and other Rapid Culture-Based Methods, PCR, FISH,
3. Biosensors/enzyme electrodes: Generalized biosensor, Electrochemical sensors, Application of biosensors. Electrochemical and microbial electrodes. Biosensor variants. ATPase based cell quantitation and Lumac system. Biochips. Microbial leaching mechanisms: biohydrometallurgy – biomining, bioleaching. Microbial enhanced oil recovery. Environmental applications of microbial technology- Designer organisms and enzyme engineering for enhanced biodegradation, evolutionary and genomic approaches, process engineering for improved biodegradation.
4. Microbial Insecticides, Commercial Products by Recombinant Microbes, Plant and animal Transgenesis. Environmental impact of genetic engineering – problems of GM foods and crops, Bti. Toxin resistance of insects - cotton bollworm, tobacco budworm, use of multiple alleles of Bti toxin genes. Environmental release and monitoring of genetically modified/engineered organisms. Milk flavor manipulation through rumen microflora, mitigating greenhouse gas emission from dairying using biotechnology.
5. Biofuels: enzymes for clean energy production – bioethanol and biofuel cells. Microbes as a health food - Spirulina and its production methods. Probiotics - use of *Lactobacilli* and *Bifidobacterium* - therapeutic and nutritional value.

6. Synthetic Biology, Applications of synthetic biology, Synthesis and Engineering Tools in Synthetic Biology, Protein Engineering, Pathway Engineering, Metabolic engineering, Synthetic Microbial Consortia and their Application, Drug Discovery and Development via Synthetic Biology.

References

1. Microbial Biotechnology. Uma Shankar Singh and Kiran Kapoor. Oxford book company, Jaipur, India. 2010.
2. Pharmaceutical biotechnology. K. Sambamurthy and Asuthosh Kar. New Age International (P) Ltd. Publishers. 2006.
3. HJ Reham and G. Reed Biotechnology (A multi-volume comprehensive treatise). Second Editon. Vol 1. Biological fundamentals. VCH publishing house mbH. 1993.
4. Microbial biotechnology fundamentals of applied microbiology, second edition. Alexander N. Glazer and Hiroshi Nikaido. Cambridge University Press. 2007.
5. Murray and Moo-Young. Comprehensive biotechnology 2nd edn. Elsevier B.V. 2011.
6. Text book of Biotechnology – Cruger and Cruger
7. Manuel of Industrial microbiology and biotechnology – Demain& Davies
8. Biotechnology of Integrated pest management – Persley
9. Principles of Fermentation technology – Stanburry PF, Whitekar
10. Fundamentals of biotechnology – Ed. Paul Prave *et al.,*
11. Biotechnology – B.D. Singh
12. Environmental biotechnology and cleaner bioprocess
13. Huimin Zhao Synthetic Biology Tools and Applications, 1st Edition, Academic Press 2013

MBG 4E05. Antibiotic action and resistance

Course objectives:
This course will equip the learner to systematically explain the antibiotic classes, mechanism of antibiotic resistance and approaches for new antibiotic discovery.

Course Outcome:

CO1	Summarize the various target sites for the action of antibiotics in bacteria	K2
CO2	Explain the mechanisms behind the development of antibiotic resistance and the genetic makeup.	K2
CO3	Discuss the importance and strategies for development of novel drugs, targets and mechanisms.	K2
CO4	Apply these principles of antibiotic resistance to combat the menace of MDR in day-to-day life.	K3
CO5	Correlate how the mechanisms studied are associated with the development of multidrug resistance in some notorious pathogens.	K4

1. Target sites in bacteria for antibiotic action.
2. Action mechanism and activity spectrum of major antibiotic classes - Aminoglycosides, Cephalosporins, Macrolides, Penicillins, Quinolones, Tetracyclines and Glycopeptides.
3. Antibiotic resistance: Significance of the problem and increase of incidence. Molecular genetics of antibiotic resistance in bacteria- role of plasmids, transposable genetic elements, DNA integration elements. Mechanism of antibiotic resistance- enzymatic destruction and modification, decreased permeability, promotion of antibiotic efflux, alteration and protection of target sites, bind-up antibiotics etc.
4. Multidrug resistance mechanism among bacteria. Multi drug resistant TB, Malaria, MRSA. Resistance to antiretroviral drugs.
5. New strategies for the discovery of novel antibiotics; New looks at targets, new molecules.

Reference

1. Christopher Walsh. *Antibiotics: Actions, Origins, Resistance*. Amer Society for Microbiology; 1 ed. 2003
2. Aníbal de J. Sosa & Denis K. Byarugaba & Carlos F. Amábile-Cuevas & Po-Ren Hsueh & Samuel Kariuki & Iruka N. Okeke. *Antimicrobial Resistance in Developing Countries*. Springer. 2009
3. Richard G. Wax & Kim Lewis & Abigail A. Salyers & Harry Taber. *Bacterial Resistance to Antimicrobials*. CRC Press. 2008

MBG 4E06. Microbial bioremediation technology

Course objectives:
The course envisages a comprehensive knowledge delivery with candidate examples in conventional and advanced bioremediation concepts.

Course Outcome:

CO1	Describe the various approaches in bioremediation technology.	K2
CO2	Compare the methods and concepts implied for monitoring the bioremediation in soil.	K2
CO3	Practice the various approaches of bioremediation for representative recalcitrant compounds persisting in the environment.	K3
CO4	Discuss the role of microorganisms and the modern technologies in the field of bioremediation.	K3
CO5	Critically evaluate the commercial use of GMOs in bioremediation and phytoremediation.	K4

1. Introduction to recalcitrant compounds. Biological remediation of Soil: An overview of Global market and available technologies, Biosurfactants in Bioremediation, Soluble Di-iron Monooxygenases with Bioremediation Applications.
2. Engineering of bioremediation processes-strategies for bioremediation of polluted soil, explosives-contaminated soil, petroleum contaminants, PCB, PAHs. Bioremediation of BTEX Hydrocarbons. Bioremediation of oil spils.
3. Advances in phytoremediation and rhizoremediation. Heavy metal phytoremediation: microbial indicators of soil health for the assessment of remediation efficiency. Industrial wastewater sources and treatment strategies.
4. Transformations of toxic metals and metalloids, biomining microorganisms and applications in biotechnology and bioremediation.
5. Bioreporter technology for monitoring soil bioremediation. Molecular tools for monitoring and validating bioremediation. Genetic engineering of bacteria and their potential for bioremediation. commercial use of GMOs in bioremediation and phytoremediation

References

1. Ajay Singh • Ramesh C. Kuhad., Owen P. Ward. *Advances in Applied Bioremediation*.Springer-Verlag Berlin Heidelberg 2009
2. Jeffrey W. Talley. *Bioremediation of relcalcitrant compounds*. Taylor & Francis group, LLC. 2005
3. John M. Walker. *Bioremediation Protocols*. Humana Press Totowa, New Jersey. 1997
4. Rosa Margesin Franz Schinner (Eds.).*Manual for Soil Analysis – Monitoring and Assessing Soil Bioremediation*. Springer-Verlag Berlin Heidelberg. 2005
5. Hans-Joachim Jördening., Josef Winter. *Environmental Biotechnology*. WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim. 2005

6. Ronald M. Atlas, Richard Bartha. *Microbial Ecology: Fundamentals and Applications* (4th Edition).Benjamin Cummings. 1997

MBG 4E07. Modern Trends in Diagnostic Microbiology and Nanobiotechnology

Course objectives:

The learner will acquire the knowledge on various approaches in diagnostic microbiology. The use of modern technologies will be discussed with possible applications in diagnosis.

Course Outcome:

CO1	Discuss the probe-based detection and identification of pathogens	K2
CO2	Illustrate the rapid serological tests for diagnosis with possible infusion of technology.	K2
CO3	Explain the use and application of nanotechnology both in pharmaceutical and diagnostic industry.	K2
CO4	Explain the profile-based microbial identification systems	K2

1. Conventional and Rapid methods for identification of bacteria and fungi: Biochemical profile based microbial identification systems.
2. Probe-based microbial detection and identification. southern and northern blotting, nucleic acid hybridization techniques, FISH. Probes and probing, RFLP, Pulsed-Field Gel electrophoresis. DNA amplification methods, PCR, Variations of PCR, Mutation detection. Diagnostic sequencing. Non PCR mediated target amplification techniques. Microarray-based Microbial identification and characterization. Genotyping of bacteria by using variable number tandem repeats. Molecular diagnoses of HIV and Hepatitis C Virus.
3. Rapid antigen tests: agglutination, immunoflorescence, EIA, Chemiluminicent methods and other rapid formats, Advanced antibody detection – ELISA, immunoblotting, RIA, CLIA, ECL and florescent immuno assays. Flow cytometric assays.
4. Nanoparticles, nanoparticles for molecular diagnostics - nanoparticles as biolabels, paramagnetic and superparamagnetic nanoparticles, role of nanobiotechnology in discovery of biomarkers, nanobiotechnology and cytogenetics,
5. Pharmaceutical applications of nanobiotechnology - drug discovery and development, nanobiotechnology-based drug delivery. Role of nanobiotechnology in biological therapies, - cell therapy, gene therapy, vaccines, antisense therapy, RNA interference etc. nanobiotechnology for the development of personalized medicine, safety issues of nanoparticles.

References

1. Murray and Moo-Young. *Comprehensive biotechnology* 2nd edn. Elsevier B.V. 2011.
2. Betty A. Forbes, Daniel F. Sahm, Alice S. Weissfeld.. *Bailey & Scott's Diagnostic Microbiology*, 12e. Mosby. 2007 Diagnostic Microbiology-V- Edition.Elmer .Keneman,Stephen D.Allen, William M. Janda.
3. Ellen JO Baron and Patrick R Murray. *Manual of clinical microbiology-9th Edition.Volume –1.* ASM Press. 2007

4. David H. Persing. *Molecular Microbiology: Diagnostic Principles and Practice*, Second Edition.ASM Press; 2 edition. 2011
5. Yi-Wei Tang., Charles W. Stratton. *Advanced Techniques in Diagnostic Microbiology*. Springer(2006)

MBG 4E08. Microbial Pest control

Course objectives:
This course will enrich the theoretical concepts of the learner in the field of pest control in agriculture by means of microorganisms.

Course Outcome:

CO1	Discuss the significance of bio-insecticides for crop protection, forest protection and insect vector control in general.	K2
CO2	Compare the mechanisms of different bacterial insecticides with a special reference to Bacillus species.	K3
CO3	Examine the formulations of the bio-insecticides and also the possibilities of integration with chemical pesticides.	K4
CO4	Appraise the commercial use of bioinsecticides over chemical pesticides.	K4

1. Bacterial Insecticide: *Bacillus thuringiensis,* -Production of *Bt, Bt* Crystal proteins and genes, insecticidal activity, mode of action, persistence, safety and ecotoxicology of*Bt,*
2. Bacterial insecticides for crop and forest protection and insect vector control -*Bacillus thuringiensis* subsp. *Kurstaki, Bacillus thuringiensis* subsp. *Israelensis,* and *Bacillus sphaericus.* Genetically modified *Bt* strains and *Bt* transgenic plants
3. Formulation of bacterial insecticides- characteristics of microbial insecticide formulations, commonly used formulations of *Bt,* improved *Bt* formulations, target-specific tailor-made formulations of bacterial larvicides, efficient effective delivery at low dose. Insect resistance to *Bt* toxins.
4. Natural and recombinant viral insecticides, biofungicides, bioherbicides, and mycoinsecticides, integrated use and commercialization of biopesticides with synthetic chemical pesticides

References

1. Jack E. Rechcigl and Nancy A. Rechcigl. Biological and Biotechnological Control of Insect Pests. CRC Press LLC. 1998
2. Sushi1 K Khetan. Microbial pest control. Marcel Dekker, Inc. 2001

UNIVERSITY OF CALICUT
DEPARTMENT OF LIFE SCIENCES

FIRST SEMESTER M.Sc. DEGREE EXAMINATION, 2020

Microbiology (CCSS Scheme)

MBG 2C09– IMMUNOLOGY

MODEL QUESTION PAPER

(2020 Admission)

Time: Three Hours Maximum : 80 Marks

Section A

Write about each of the following in 2 ***or*** *3 sentences.*
Each question carries 2 marks.

1. Secretory IgA.
2. Genetic polymorphism in MHC molecules.
3. Hypervariable regions in immunoglobulins.
4. CLIP.
5. Isotype switching
6. Adjuvants.
7. Opsonisation.
8. Immunofluorescence.
9. Allelic exclusion in Ig gene expression.
10. Serum sickness
11. Coombs test
12. MHC restriction.
13. Immunoglobulin allotype
14. Immunoglobulin hinge region.
15. Widal test.
16. Radioimmunoassay.
17. Apoptosis
18. Immunological tolerance.
19. Affinity maturation of B cells.
20. Atopy

(20 x 2 = 40 marks)

Section B

Write notes on or discuss any ***Five*** *of the following.*
Each question carries 8 marks.

21. Antigen processing and presentation.
22. MHC class I molecule.
23. Development and maturation of B lymphocytes.
24. Autoimmune diseases.
25. Transplantation immunology
26. Monoclonal antibodies and hybridoma technology.
27. Classical pathway of complement system.

(5 x 8 = 40 marks)

M.Sc. Human Physiology (CCSS)

Ability Enhancement Course (AEC)

2 Credits

Recommended courses – Publications/ Book review/Seminar presentation

Theoretical knowledge required

Academic writing in science - Types of research papers, structure of research paper, reading a research paper and basics of writing a research paper

Language aspects of research paper, revising the paper, responding to peer reviews etc.

Ethical aspects of research writing, plagiarism.

Evaluation method

Theoretical knowledge assessed through written test
Paper published in UGC approved peer reviewed journals/Book reviews submitted by the student in the concerned subject area/seminar paper/poster presentation in state level/national/international seminars based on original works.

Professional Competency Course (PCC)

2 credits

Practical knowledge required

Application of different softwares such as SPSS/Design expert/ or any statistical software.

Data analysis and graph preparation.

Application of bibliography management softwares such as mendley and zotero.

Systematically searching the literature for systematic reviews, Evidence Based Case Reports etc.

Preparing effective presentations, power point/impress etc.

Evaluation method

Practical knowledge assessed performance test