Ph.D MICROBIOLOGY
COURSE WORK

(With effect from the Academic Year 2017-18)

Department of Biology

The Gandhigram Rural Institute Deemed University

(MHRD, Govt. of India)

Accredited by NAAC with ' A' Grade (3rd Cycle)

Gandhigram- 624 302

Dindigul District, Tamil Nadu

Ph.D MICROBIOLOGY

SCHEME

FIRST SEMESTER							
	Course Code	**Course title**	**C**	**L**	**E**	**ESE**	**Total**
Core Courses	17MBR0101	Recent Trends in Microbiology	4	4	3	100	100
	17MBR0102	Agricultural Microbiology	4	4	3	100	100
	17MBR0103	Microbial Technology	4	4	3	100	100
Supportive Course	17MBR0104	Research Methodology	4	4	3	100	100
		Total Credits	**16**				

SECOND SEMESTER							
	Course Code	**Course title**	**C**	**L**	**E**	**ESE**	**Total**
Supportive Course	17MBR0205	Quantitative Techniques – Advanced Biostatistics	4	4	3	100	100
Core Course	17MBR0SX	Area of Specialization on Thrust Areas*	4	4	3	100	100
Seminars		Seminar -1	1	2	-	-	-
		Seminar -2	1	2	-	-	-
		Seminar -3	1	2	-	-	-
		Term paper on Topical Research	1	2	-	-	-
		Total Credits	**12**				

Research Credits			
	Course Code	**Course title**	**C**
		a) Project Planning including literature collection, finalization of objectives and methodology	4
		b) Field/ Lab Studies, Data Collection, compilation of results, statistical analysis, results and final conclusion	32
		c) Synopsis and thesis submission, final viva	6
		Total Credits	**42**
OVERALL CREDITS - 70			

	List of Area of Specialization on Thrust Areas*
17MBR0S-1	1. Food Microbiology
17MBR0S-2	2. Agriculture Microbiology
17MBR0S-3	3. Microbial Biotechnology
17MBR0S-4	4. Environmental Microbiology

C- Credits
L- Lecture Hours
E- Exam Hours
ESE- End Semester Examinations

***Detailed Syllabus for Area of Specialization may be prepared by the respective Doctoral Committee.**

17MBR0101 RECENT TRENDS IN MICROBIOLOGY Credits: 4

Objectives:

This course gives an insight to microbial biotechnology covering topics viz., fermentation, product development trends in bacterial taxonomy, gene technology and its application. It also develops the skills to understand and critically evaluate research actives in various emerging areas of microbiology.

Learning Outcomes:

- To have an in depth knowledge on fermentation, upstream and downstream processsing
- To get conceptual ideas on biotransformation with examples Bioremediation and biosensors
- To acquire knowledge on recent advances in Bacterial Taxonomy
- To know about gene technology and its usefulness for genome sequencing
- To have an idea on application of microbial gene technology, bio safety and Bioethics.

Unit – I:

Concepts and Scope in microbial bio-technology- Fermentation technology – Model fermenters – bioprocess monitoring – Down stream processing. Immobilization of microbial cells / enzymes – Adsorption, entrapping, ionic bonding, cross linking, encapsulation and microencapsulation. Application of immobilized enzymes. Gene banks and Germ plasm storage.

Unit-II:

Biotransformation and production of useful compounds – Glycerol, acetone, Alkene oxide, Ploy hydroxy butyrate and Xanthangum - Microbial Leaching. Bioenergy products – ethanol, biogas and Hydrogen. Bioremediation – microbial degradation of xenobiotics. Biosensors – definition, outline design and types – Biosensors nutrients – glucose and acetic acid sensors. Sensor for cell population – Fuel cell type electrode, potentiostatic, piezoelectric membrane – Dye-coupled electrode membrane filter – Oxygen electrode system and Lactate sensor. Biosensor for products - alcohol sensor, formic acid sensor and methane sensor. Biosensor for environmental control – BOD sensor, Ammonia sensor, Nitrite sensor and Sulfite Ion sensor.

Unit III:

Recent advances in Bacterial Taxonomy - Identification of Procaryotes - phylogenetic backbone and taxonomic framework for prokaryotic systems - road map to the use of the current Bergey's Manual - Computer taxonomy - 16s rRNA fingerprinting and lipid profile by GLC b. Microbial sources of pharmaceutically important compounds. Quorum sensing– intercellular signaling and its uses.

Unit – IV :

Microbial Gene Technology: Enzymes - DNA polymerase, restriction endonucleases, topisomerase I and DNA ligase, reverse transcriptase, kinase, alkaline phosphatase, nuclease, RNAse H. Vectors: plasmids;(PBR 322, pUC, Ti), Cosmids, bacteriophage, M13 vectors, BAC, and YAC - Blotting techniques - DNA sequencing by Maxam & Gilbert's chemical method and Sanger's dideoxy chain termination method - cDNA library – screening by oilgonucleotide probe, nick translation, site directed mutagenesis, linkage analysis. Gene cloning - General strategy for gene cloning, transformation. Gene Silencing, Geneknock out and gene therapy.

Unit-V :

Applications of microbial gene technology: Genetically modified microorganisms and its applications in the fields of food & dairy industry, agriculture & animal husbandry, pharmaceutical industry and environment & Energy sectors. Hazards of environmental engineering - Biosafety and bioethics.

References:

1. Dubey R.C., 2001. A text book of Biotechnology 1st Edition. S.Chand & Company Ltd., New Delhi. Pg. 43-80; 113-197; 331-391.
2. Chhatoval G.R., 1995. Text book of Biotechnology, 1st Edi, Anmol Publications Pvt. Ltd., New Delhi.
3. Glick, B.R. and Pasternak, J.J 1994. Molecular Biotechnology, ASM Press, Washington DC.
4. Demain, A.L., Solomon, N.A. 1986. "Manual of Industrial Microbiology and Biotechnology", ASM Press, Washington.
5. Sambrook J, Fritsch E. F. and Maniatis (1989) Molecular cloning, vol. I, II, III, II nd edition, Cold spring harbor laboratory press, New York.
6. DNA Cloning : A practical approach D.M. Glover and D.B. Hames, RL Press, Oxford, 1995
7. P.B. Kaufman, W. Wu , D. Kim and L.J. Cseke, 1995. Molecular and cellular methods in Biology and Medicine, CRC Press Florida
8. Berger and A. R. Kimmel, 1996. Methods in Enzymology Guide to Molecular Cloning Techniques, Vol. 152 S.L. Academic Press Inc, San Diego,
9. D. A. Mickloss and G. A Freye 1990. Methods in Enzymology Gene Expression Technology, Vol. 185D. V. Goedel, Academic Press Inc, San Diego,
10.. S. B. Primrose 1994. Molecular Biotechnology, 2nd Ed., Blackwell Scientific publishers, Oxford,

Web resources:

http://microbiology.ucsc.edu

http://www.asm.org

LECTURE SCHEDULE: RECENT TRENDS IN MICROBIOLOGY

Unit	Lecture No.	Topics	Lecture Delivery Mechanism
I	1	Concepts and scopes in Microbial biotechnology	Lecture
	2	Fermentation technology- model fermenters- bioprocess monitoring- Down streaming processing	Lecture/animation /video
	3	Immobilization of microbial cells/ enzymes- Adsorption, entrapping ionic bonding, cross linking, encapsulation and micro encapsulation	PPT
	4	Application of immobilized enzymes	Lecture
	5	Gene banks and Germ plasm storage	PPT
II	6	Biotransformation and production of useful compounds- Glycerol, acetone alkene oxide, Ploy hydroxyl butyrate, Xanthangum and microbial leaching	Lecture
	7	Bioenergy products- Ethanol, biogas and hydrogen	PPT
	8	Bioremediation -microbial degradation of xenobiotics	PPT
	9	Biosensor- definition, outline design and types- Biosensor nutrients- glucose and acetic acid sensors	Lecture/animation /Video
	10	Sensor for cell population – fuel cell type electrode, potentiostatic, piezoelectric membrane- Dye coupled electrode membrane filter- oxygen electrode system and lactate sensor	Lecture
	11	Biosensor for products- alcohol sensor, formic acid sensor and methane sensor	Lecture
	12	Biosensor for environmental control- BD sensor, Ammonia sensor, Nitrite sensor and sulfur ion sensor	PPT
III	13	Recent advances in bacterial taxonomy- identification of prokaryotes	Lecture
	14	Phylogenetic backbone and taxonomic framework for prokaryotic systems and A road map to use of the current Bergy's Manual	Lecture Flashcards
	15	Computer taxonomy and 16 s r RNA fingerprinting and lipid profile by GLC	Lecture software
	16	Microbial sources of pharmaceutically important compounds	PPT
	17	Quorum sensing and microbial hormones- inter cellular signaling	Lecture/videos
IV	18	Microbial Gene technology- Enzymes; DNA Polymerase, restriction endonuclease, topo isomerase I and DNA ligase, reverse transcriptase, Kinase, alkaline phosphatase, nuclease, RNA se	Lecture
	19	Vectors: Plasmids; (pBR322, pUC, & Ti), Cosmids, bacteriophage, M13 vectors, BAC and YAC	Lecture

	20	Blotting techniques and DNA sequencing by Maxam & Gilbert's Chemecal method and Sangerr's dideoxy chain termination method	PPT
V	21	C DNA library- screening by oligo nucleotide probe, nick translation, site directed mutagenesis, linkage analysis	PPT
	22	Gene cloning- general strategy for gene cloning, transformation	Lecture/video
	23	Application of gene technology, gene silencing, Geneknock out of gene therapy	Lecture /video
	24	Applications of microbial gene technology: Genetically modified microorganisms and its applications in the fields of food & dairy industry	Lecture
	25	Genetically modified microorganisms and its applications in agriculrture & animal husbandry, pharmaceutical industry and environment & Energy sectors.	Lecture
	26	Hazards of environmental engineering - Biosafety and bioethics.	Lecture

17MBR0102 ADVANCES IN AGRICULTURAL MICROBIOLOGY Credits: 4

Objectives:

To impart knowledge on role of microorganisms in agriculture microbiology.
Enhancing crop productivity using microbial technology

Learning outcomes:

- Would get an in-depth information on Soil microbiology and biogeochemical cycles
- Known to the details of nitrogen fixing microbes and Biological nitrogen fixation
- Able to understand Plant pathology- disease resistance of plants and biopesticides
- To know the basics composting and enrichment of compost using micro-organisms

Unit – I:

Composition of Lithosphere, Soil Microbes, Factors influencing soil microbial population. Role of microbes in biogeochemical cycle - Nitrogen, Carbon, Sulphur and Phosphorous cycle. Role of microbes on plant growth. Rhizosphere Effect.

Unit – II:

Bacterial Nitrogen fixation and its mechanism - Ammonia assimilation in Nitrogen-Fixing legume nodules-Hydrogen Metabolism, action of Hydrogenase - factors controlling the Legume - Rhizobium symbiosis. Role of Soybean lectin in the Soybean - Rhizobium japonicum Symbiosis.

Unit – III:

Non Leguminous associations – *Azotobacter* sp and *Azospirillum* sp and their functions - *Cyanobacteria* (BGA) and their associations in Nitrogen fixation - Photosynthesis and N_2 fixation interactions. Phospahte solubilizing microbes - Role of biofertilizers.

Unit – IV:

Plant pathogenic microorganisms - Algal, fungal, bacterial, viral, mycoplasma, Nematode diseases and symptoms. Mode of entry of pathogens and factors affecting disease incidence - Plant disease resistance and various control measures. Phenolic compounds. Interaction of plant pathogens with host. Biopesticides against pathogens.

Unit – V:

Composting of agro residues- types of agro residues. Enrichment of compost using *Azotobacter*, Phosphate solubilizing microorganisms- method of enrichment-chopped versus unchopped straw for compost enrichment, role of compost activators/ inoculants- screening and mass multiplication of cellulolytic cultures.

References:

1. Subba Rao, N. S. (1997). Biofertilizers in Agriculture and Forestry, III Ed., Oxford &IBH Publishing Co.Pvt.Ltd.,New Delhi.
2. Patel A.H. (1996). Industrial Microbiology, Macmillan India Limited.
3. Wheeler, B. E. (1976). An Introduction to Plant Disease. ELBS and John Wiley and Sons, Ltd.
4. Subba Rao, N. S. (1995). Soil Microorganisms and Plant growth. Oxford & IBH Publishing Co.Pvt.Ltd. New Delhi.
5. Glick, B.R. AND Pasternak, J.J (1994). Molecular Biotechnology, ASM Press, Washington DC. pp: 289-302.
6. Purohit, S. S., Kothari, P. R. and Mathur (1993). Basic and Agricultural Biotechnology, Agrobotanical Publishers (India). Bikaner.
7. Gaur, A.C., (1999). Microbial technology for Composting of Agricultural Residues by Improved Methods, 1st print, ICAR, New Delhi.

Webresources:

http://testweb.science.uu.nl/pmi/

www.researchgate.net/...the rhizosphere microbiome and plant health

LECTURE SCHEDULE: ADVANCES IN AGRICULTURAL MICROBIOLOGY

Unit	Lecture. No	Topics	Lecture delivery mechanism
I	1	Composition of lithosphere	Lecture
	2	Soil microbes, factors influencing soil microbial population	Lecture
	3	Role of microbes in biogeochemical cycle: Nitrogen, carbon, phosphorus and sulphur	Lecture
	4	Role of microbes in plant growth, Rhizosphere effect	PPT/video
II	5	Bacterial nitrogen fixation and its mechanism- Ammonia assimilation in nitrogen fixing legume nodules	Lecture/PPT
	6	Hydrogen metabolism, action of hydrogenase	Lecture/PPT
	7	Factors controlling the legume- Rhizobium symbiosis	Lecture
	8	Role of soybean lectin in soybean- Rhizobium japonicum symbiosis	Lecture
III	9	Non leguminous associations- *Azotobacter* sp and *Azospirillum* sp and their functions	Lecture
	10	Cyanobacteria (BGA) and their associations in nitrogen fixation	Lecture
	11	Photosynthesis and nitrogen fixation interactions	PPT
	12	Phosphate solubilizing microbes. Role of bio fertilizers	Lecture

IV	13	Plant pathogenic micro organism- Algal, fungal, bacterial. Viral, mycoplasma	Lecture
	14	Nematode diseases and symptoms	Lecture
	15	Mode of entry of pathogens and factors affecting disease incidence	PPT
	16	Plant disease resistance and various control measures	PPT
	17	Phenolic compounds	Lecture
	18	Interactions of plant pathogens with host	PPT
	19	Biopesticides against pathogens	Lecture
V	20	Composting of ago residues- Types of agro residues	Self study
	21	Enrichment of compost using *Azotobacter*, phosphate solubilizing microorganisms	Lecture
	22	Methods of enrichment chopped versus unchopped straw for compost enrichment	Lecture
	23	Role of compost activators/ inoculants- Screening and mass multiplication of cellulolytic cultures	Lecture

17MBR0103 MICROBIAL TECHNOLOGY Credits: 4

Objectives:

To acquire an overall knowledge on microbial technology in topics viz., culture selection, fermentor design and use of microbes to develop useful products

Learning outcomes:

- To improve the knowledge on fundamentals of microbial technology and culture maintenance
- To have a complete knowledge about industrial microbiology
- To gain knowledge on the fermenter and fermentation technology including fermentation economics
- To have in depth knowledge on importance of microbes and potentiality of microbes as biofertilizers, biopesticides and biofuel
- Be able to understand Microbial production; secondary metabolites; and their functions in bioremediation. To gain knowledge in patent filing and entrepreneurship

Unit –I:

Microbial fundamentals and biochemical engineering: Various methods for isolation of pure culture methods for measurement of microbial growth, manipulation of environment, nutritional and genetic parameters for over production of metabolites, maintenance and preservation of microbes (pure culture).

Unit –II:

Industrially important microbes-Screening and Strain improvement - Induced and site directed mutagenesis - Genetic variants. Design of production nutrient media - alternative carbon and nitrogen sources, pretreatment of carbon, growth kinetics. - Media formulation – Sterilization. Inoculum development for different fermentation processes.

Unit –III:

Design of fermenter: material for construction, aeration, agitation, sterilization of gases and liquids, on-line and off line monitoring of rheological parameters, scale-up, computer application, types of fermenters, solid state (substrate) fermentation, process economics, fermentation economics.

Unit –IV:

Importance and use of microorganisms in food, feed & probiotics - Production of food- SCP – spirulina, mushrooms, bakers yeast and probiotics. Biofertilizer - BGA, *Azospirillum, Rhizobium,* Phosphobacterium, *Azolla-Anabaena*. Biopesticides- Bacterial, fungal and viral. Biofuel - Methane, Ethanol, Hydrogen and biodiesel. Fine chemicals – restriction enzymes and toxins.

Unit –V:

Microbial production of Organic solvents and acids: Alcohol, acetone-butanol, vinegar and citric acid. Beverages: Wine, beer, rum, whisky. Amino acids: Tryptophan, flavor enhancers- MSG. Vitamins: Vitamin B12 Enzymes: Amylases, proteases. Exopolysaccharides: Xylan- Plant growth promoting substances: IAA & GA Microbiology of Pharmaceuticals- Antibiotics: Penicillin, streptomycin, rifamycin, semisynthetic antibiotics. Anticancer agents: Nucleoside analogs, enzyme-1-asparginase, MAB, interferon. Biopharmaceuticals: TPA. Bioremediation - Biotransformation reactions - Biotransformation-definition, scope and in detail any one antibiotic, aminoacid and steroids- Bioplastics (PHA) - Patent and Entrepreneurship.

References.

1. Microbial Technology by H. J. Peppler. Academic Press
2. Annual Reviews in Microbiology Volume 48 by L. N. Ornston, A. Balows and E. P. Greenberg (eds). Academic Press
3. Enzyme Biotechnology by S. Sridhar
4. Food Microbiology by M. R. Adams and M. O. Moss
5. Dairy Microbiology Volumes 1 and 2 by R. K. Robinson.
6. Fermentation Microbiology and Biotechnology by E. M. T. El-Mansi and C. F. A. Bryce.
7. Microbiological Aspects of Pollution Control by Dart and Stretton. Surabhi Publishers, Jaipur

Webresource:

http://www.scrib.com/doc/46151150/fermentationtechnology
http://www.chalmers.se/en/areas.of.advance/research/pages/fermentation.technology.aspx
http://www.who.int/foodsafety.html

LECTURE SCHEDULE: MICROBIAL TECHNOLOGY

Unit	Lecture. No	Topics	Lecture delivery Mechanism
I	1	Microbial fundamentals and biochemical engineering; various methods for isolation of pure culture methods for measurement of microbial growth	Lecture
	2	manipulation of environment	PPT
	3	nutritional and genetic parameters for over production of metabolites	PPT
	4	Maintenance and preservation of microbial growth	PPT

II	5	Industrially important microbes- Screening and strain improvement	Lecture
	6	Induced and site directed mutagenesis, genetic variations	Lecture
	7	Design of production of nutrient media- alternative carbon and nitrogen sources, pretreatment of carbon	PPT
	8	Growth kinetics	PPT
	9	Media formulation sterilization	Lecture
	10	Inoculum development for different fermentation process	Lecture
III	11	Design of fermenter: material for construction, aeration, agitation,sterilization of gases and liquids	PPT
	12	Online and offline monitoring of rheological parameter. Scale up, computer application	PPT
	13	Types of fermenters, solid state fermentation	Lecture/video
	14	Process economics, fermentation economics	Lecture
IV	15	Importance and use of microbes in food, feed and probiotics	Lecture
	16	Production of food-SCP-Spirullina, mushrooms, baker's yeast	Video
	17	Biofertilizer- BGA. Azospirillum, Rhizobium, phosphobacterium, Azolla-Anabena	PPT
	18	Biopesticides- Bacterial, fungal and viral	PPT
	19	Biofuel- methane, ethanol, hydrogen and biodiesel	PPT
	20	Fine chemicals- restriction enzymes and toxins	PPT
V	21	Microbial production of organic solvents and acids; alcohol, acetone-butanol, vinegar and citric acids	Lecture/video
	22	Beverages: wine, beer, rum, whisky	Lecture/video
	23	Amino acids: Tryptophan, flavor enhancers- MSG	Lecture
	24	Vitamins: Vitamin 12 enzymes: Amylases, proteases	Lecture
	25	Exopolysaccharides: xylan- plant growth promoting substances: IAA,GA	Lecture
	26	Microbiology of pharmaceuticals: Antibiotics- penicillin, streptomycin, rifamycin, semisynthetic antibiotics	Lecture
	27	Anticancer agents; nucleoside analogues, enzyme -1 asparaginase, MAB, interferon.	PPT
	28	Biopharmaceuticals: TPA	Lecture
	29	Bioremediation: Biotransformation reactions- Biotransformation- definition, scope and in detail any one antibiotic, amino acid and steroids, Bioplastics- patent	Lecture

17MBR0104 RESEARCH METHODOLOGY Credit: 4

Objectives:

To enable the students:

- To understand the working principles, construction and applications of the instruments used in the studies related to various disciplines of biological sciences.
- To expose the students on the basic understanding of research concepts and learn the art of thesis & paper writing, publication and scientific ethics.

Learning outcomes:

- The students are be able to understand the working principle, operation system and importance of pH meter and various Microscopes.
- The students are be able to understand the working principle, operation system and importance of centrifuge, photometers and chromatography.
- The students are be able to understand the working principle, operation system and importance of molecular techniques.
- The students are be able to understand the overall concepts of Research and art of writing Thesis
- The students are be able to understand art of writing research articles, publication and scientific ethics.

Unit I : pH meter, microscopic and polarimetric techniques:

pH meter - types, basic principle, operation and application; Buffers-principle, standards and preparation of buffer; pH determination & pH indicators. Microscopy – Principle, operation and application - simple, compound, light-field, dark-field, phase–contrast, fluorescence, confocal and electron microscopy. Micrometry-principle and application. Polarimetry -principle and application. Experiments on buffer preparation and pH determination. Exposure to various microscopes.

Unit II : Centrifuge, Photometric and Chromatographic techniques:

Centrifugation-types, principle and application. Photometry - Principle, operation and application-colorimeter, spectrophotometer, flame photometer, bomb calorimeter, UV-Visible spectroscopy, atomic absorption spectroscopy, mass spectroscopy and FTIR spectroscopy. Chromatography– types, principle and application: paper chromatography, thin layer chromatography, column chromatography, Ion Exchange, GC-MS and HPLC. Demonstration on differential and gradient centrifugation Demonstration on verification of Beer-Lamberts law. Demonstration on chromatographic separation of amino acids and sugars. Experiment on ARA.

Unit III: Molecular techniques:

Electrophoresis - Principle and applications, paper electrophoresis, agarose gel-Polyacrylamide gel electrophoresis (PAGE and SDS- PAGE) and immuno electrophoresis. Molecular techniques- Microarray, MALDI-TOF,Amino acid sequencing-DNA sequencing (Enzymatic & Chemical methods) Blotting techniques-southern, northern and western blottings and PCR techniques. RAPD, RFLP and ARDRA techniques. Demonstration/experiments on isolation, separation of DNA and Protein molecules by electrophoresis techniques.

Unit IV : Research and Thesis writings:

Research –definition, objectives, types and importance – Research methods in biological Sciences –Research process – Literature survey – sources – scientific databases – Research report writing – Parts of thesis and Dissertation – Title, certificate, declaration, acknowledgements, contents, list of tables, figures, plates & abbreviations, Introduction, Review of literature, Materials and methods – Results – Presentation of data - Tables, figures, maps, graphs, photographs – Discussion – Summary, bibliography / References and Appendix.

Unit V : Research Publication and Project writing:

Writing scientific paper: Importance of title – abstract – key words, Introduction, Materials and Methods, Results, Discussion, Acknowledgements and References – Publication on research journals – Standards of research journals – peer review – impact factor –citation index. Proof correction – proof correction marks –Method of correction proof. Writing chapters in books. – Preparation of Research proposal and funding agencies – Research fellowships. Ethics in science reporting – Reproduction of published materials – Plagiarism & Anti –Plagiarism check – citation and acknowledgement. Biosafety levels – IBC – Institutional ethical committees – IPR & IPP.

References:

1. David.T Plummer (2009). An Introduction to Practical Biochemistry, Tata Mc Graw Hill Pub.Co.Ltd, New Delhi.
2. N.Gurumani (2006).Research Methodology for Biological Sciences. MJP Publishers, Chennai.
3. K.Kannan (2003). Hand book of Laboratory Culture media, reagents, stains and buffers. Panima Publishing Corporation, New Delhi
4. Glick, B.R and Pasternak.J.J.,(2003). Molecular Biotechnology, ASM Press, Washington.DC.
5. P.Asokan (2002).Analytical biochemistry-Biochemical techniques. First Edn. China Publications, Melvishoram, Vellore.
6. Rajbir Singh (2002).Chromatography 1st Edition Mittal Publications, New Delhi.
7. Keith Wilson and John Walker (2002). Practical Biochemistry-Principles and techniques. 5thEd.Cambridge Univ.Press, London.
8. James.D.Watson, Michael Gilman,JanWit Koeski and Mark Zuller(2001). Recombinant DNA. IInd Ed.Scientific American Book. New York.
9. Rodney Boyes(2001). Modern Equipmental Biochemistry. III Ed Addison Wesley Longman Pvt.Ltd., Indian Branch ,Delhi.
10. S.Palanichamy and M.Shanmugavelu.(1997). Research methods in biological sciences. Palani Paramount Publications, Palani.

Web resources:
Pub Med search engine for database of references and abstracts on life sciences and biomedical topics: https://en.wikipedia.org/wiki/PubMed.

Plagiarism Software: Online plagiarism checker for checking articles: https://www.plagiarismsoftware.net/ and www.urkund.com/en/

LECTURE SCHDULE: RESEARCH METHODOLOGY

Unit	Lecture No.	Topics	Lecture delivery Mechanism
I	1	pH meter - types, basic principle, operation and application	Lecture +PPT
	2	Buffers-principle, standards and preparation of buffer; pH determination & pH indicators.	Lecture +PPT
	3	Principle, Operation and application of simple, compound, light-field microscopes	Lecture +PPT
	4	Principle, Operation and application of dark-field, phase-contrast, fluorescence microscopes	Lecture Exposure visit
	5	Principle, Operation and application of confocal and electron microscopy.	Lecture Exposure visit
	6	Micrometry-principle and application.	Lecture +PPT
	7	Polarimetry -principle and application	Lecture +PPT
	8	Experiments on buffer preparation and pH determination. Exposure to various microscopes.	Practical Demo
II	9	Centrifugation-types, principle and application	Lecture +PPT
	10	Principle, Operation and application of colorimeter, spectrophotometer, flame photometer, bomb calorimeter,	Lecture +PPT
	11	Principle, Operation and application of UV-Visible spectroscopy, atomic absorption spectroscopy, mass spectroscopy and FTIR spectroscopy.	Lecture Exposure visit
	12	Chromatography– types, principle and application: paper chromatography, thin layer chromatography, column chromatography & Ion Exchange	Lecture +PPT
	13	Principle, Operation and application of GC-MS and HPLC.	Lecture Exposure visit
	14	Demonstration on differential and gradient centrifugation	Practical Demo
	15	Demonstration on verification of Beer-Lamberts law.	Practical Demo
	16	Demonstration on chromatographic separation of amino acids and sugars & Experiment on ARA.	Practical Demo
	17	Electrophoresis- Principle and applications	Lecture
	18	Paper and agarose gel electrophoresis,	Lecture Exposure visit

III	19	Polyacrylamide gel electrophoresis (PAGE and SDS-PAGE) and immuno electrophoresis.	Lecture Exposure visit
	20	Microarray, MALDI-TOF and Amino acid sequencing	Lecture Exposure visit
	21	DNA sequencing (Enzymatic & Chemical methods)	Lecture Exposure visit
	22	Blotting techniques-southern, northern and western blottings and their applications	Lecture Exposure visit
	23	PCR, RAPD, RFLP and ARDRA techniques and their applications	Lecture Exposure visit
	24	Demonstration/experiments on isolation, separation of DNA and Protein molecules by electrophoresis techniques.	Practical Demo
IV	25	Research- Definition, objectives, types and importance	Lecture +PPT
	26	Research methods in Biological Sciences- Research process	Lecture +PPT
	27	Literature survey- sources- scientific databases	Lecture + Library visit
	28	Research report writing – Parts of thesis and Dissertation – Title, certificate, declaration, acknowledgements, and contents – list of tables, figures, plates & abbreviations.	Invited Lecture
	29	Parts of thesis: Introduction, Review of literature, Materials and methods	Invited Lecture
		Parts of thesis: Results – Presentation of data - Tables, figures, maps, graphs, photographs – Discussion – Summary, bibliography / References and Appendix	Invited Lecture
V	30	Writing scientific paper – Importance of title – abstract – key words, Introduction, Materials and Methods, Results, Discussion, Acknowledgements and References	Invited Lecture
	31	Publication on research journals – Standards of research journals – peer review – impact factor –citation index	Invited Lecture
	32	Writing chapters in books	Invited Lecture
	33	Proof correction – proof correction marks –Method of correction proof	Invited Lecture
	34	Preparation of Research proposal and funding agencies – Research fellowships	Invited Lecture
	35	Ethics in science reporting – Reproduction of published materials – Plagiarism & Anti –Plagiarism check – citation and acknowledgement.	Invited Lecture
	36	Biosafty levels – IBC – Institutional ethical committees – IPR & IPP.	Class Room Discussion

17MBR0205 QUANTITATIVE TECHNIQUES- ADVANCED BIOSTATISTICS Credits- 4

Objective:

To provide students with a basic understanding of the principles of statistical measures as applied to biological Sciences.

Learning Outcomes:

Upon completion of the course, the students will be able to perform the following:

- Choose appropriate statistical measures to analyze biological data.
- Students may try a few "Bio- Statistics tutorial" available in the internet.
- Select an appropriate measure, test and make interpretation of the results in biological experiments.
- Create and interpret visual representation of quantitative data in biological research.
- Understand different rates, ratios and Odds ratio required to interpret biological data.

UNIT- I:

Descriptive Statistics: Types of data; Measures of central value; Variability Measures, Skewness measures; Computational Tools: SPSS, MATLAB, DMRT; Origin Software; NCBI online Tools on sequence alignment and physiological tree analysis

UNIT- II:

Sampling and sample Designs: Census VS Sample methods- Laws of sampling; Sampling Techniques, Determination of Sample size; Merits and Demerits of Sampling and Non- Sampling errors; Reliability of samples.

UNIT- III:

Probability and Theoretical distributions: Basic concepts in probability, Definition of Probability, Approaches to probability; Theoretical Distributions- Simple problems in Binomial, Poisson and Normal Distributions with biological applications.

UNIT- IV:

Correlation Techniques: Simple Correlation and Regression problems; Multiple Correlation and Regression Analysis; Logistic Regression Analysis, Factor Analysis; Discriminant Analysis; Cluster Analysis; Illustration with SPSS; Bio- assays and odds ratios.

UNIT- V:

Inferential Statistics; Basic concepts; Type- I and Type- II errors; Steps in Hypothesis Testing; Different Test procedures; Analysis of variance and Design of Experiments; Multiple comparisons Least significant difference Test; Analysis of Covariance.

References:

1. Vijayalakshmi. G and C. Sivapragasam (2009)Research methods; Tips and Techniques, MJP publishers, Chennai
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E-resources:

1. Data analysis: Online manuals and guides to software packapes, SSPS product file: http://www.spss.com/statistics.
2. Practical examples for the analysis of Surveyhttp://www2.napier.ac.UK/depts/fhls/peas/index.htm
3. Research methods and statistics arena http://www.research methodsarena.com/resources/ resources .asp
4. Analysis of statistics and quantitative data analysis website:www.data-archive.ac.UK
5. Resource for methods in evaluation in Social research http://gsociology.icaap.org/methods/.
6. Data analysis: Online tool : https://www.ncbi.nlm.nih.gov/

LECTURE SCHEDULE: QUANTITATIVE TECHNIQUES- ADVANCED BIOSTATISTICS

Unit	Lecture	Topic	Lecture Delivery Mechanism
I	1 to 12	Introduction and Types of data, Central measures, Variability Measures and Skewness Computational Tools	Lecture Practical Practical Lecture + Practical
II	1 to 12	Introduction; Census VS Sample. Laws of Sampling and Sampling Techniques Determination of Sample size Merits and Demerits of sampling Sampling and Non- sampling errors	Lecture Self study Lecture Self study Self study
III	1 to 12	Probability- Basic concepts Approaches in Probability Computation of Probability- Simple problems in Binomial, Poisson and Normal Distributions	Lecture Lecture Lecture and Practical Lecture+ Practical
IV	1 to 14	Correlation and Regression- concepts Simple problems Multiple Correlation and Regression Analysis Logistic Regression Factor Analysis Discriminant Analysis, Cluster Analysis Bio-assays and adds ratios	Self study Lecture+Practical Lecture+Practical Lecture+Practical Lecture+Practical Lecture+Practical Lecture+Practical Lecture+ Practical
Unit V	1 to 14	Basic concepts Type I and Type II errors Steps in Hypothesis Testing Test procedure Design of Experiments, Analysis of Variance Multiple comparisons, Least significance difference Test; Analysis of Covariance	Lecture Lecture Lecture Lecture Lecture+Practical Lecture+Practical Lecture+Practical Lecture+Practical

In this online microbiology course, "Introduction to Medical Microbiology", our goal is not only to introduce you to the principles of infectious disease but also to provide you with the confidence and resources to dive deeper into this important subject once you have completed this course. We aim to provide a positive, supportive, and socially engaging experience. Discussions with instructors and classmates are facilitated through the use of the most modern education management tools currently available. The designers of this course have trained with the University of Toronto's Microbiology Graduate Courses. The program of coursework taken by MS and PhD students is jointly decided by the student and their Graduate Committee. The Microbiology Program requires first year students to take a sequence of core courses: MB 511, 512, 513 and GRAD 520. Students have substantial latitude in choosing additional courses from among Microbiology (MB) listings and courses in other colleges and departments that are pertinent to their program. All microbiology and some other relevant graduate classes are listed below. (S=Spring; F=Fall, W=Winter); (cr=credit).Â Teams of students will work with faculty mentors to complete a research project. Course Syllabus. MB 668. Most microbiology majors take core courses in microbial genetics and microbial physiology and elective classes such as environmental microbiology and virology. Students also should take classes in other sciences, such as biochemistry, chemistry, and physics, because it is important for microbiologists to have a broad understanding of the sciences. Courses in statistics, math, and computer science are important for microbiologists because they may need to do complex data analysis.Â Ph.D. programs usually include class work, laboratory research, and completing a thesis or dissertation. Microbiologist Training. Many microbiology Ph.D. holders begin their careers in temporary postdoctoral research positions.