

Scheme of Studies for M.Phil, Department of Pathobiology (Microbiology), Bahauddin Zakariya University Multan

Mission

Development of human resource capable of (i) providing education and training in all aspects of Microbial diseases and their pathogenesis, (2) conducting basic and applied researches in Microbial diseases and their control, (3) providing laboratory services in the diagnosis of Microbial diseases, and (4) provide extension services in the planning, implementation and evaluation of Microbial diseases control programs.

PROPOSED COURSES		
Course No.	Course Title	Credit hours
For M. Phil Program		
MICR-601	Advanced Microbiological Techniques	3 (2-2)
MICR-602	Microbial Zoonoses	3 (2-2)
MICR-603	Advanced General Microbiology	3 (2-2)
MICR-604	Advanced Immunology	3 (2-2)
MICR-605	Advanced Bacteriology	3 (2-2)
MICR-606	Advanced Virology	3 (2-2)
MICR-607	Advanced Mycology	3 (2-2)
MICR-608	Microbial Physiology	3 (2-2)
MICR-609	Special Problem	1 (1-0)
MICR-610	Seminar	1 (1-0)
MICR-611	Dairy and meat Microbiology	3 (2-2)
MICR-612	Bio- safety and risk management	3 (3-0)
Total		32

NOTE:

1. For the award of degree for M. Phil Microbiology Research and Thesis carries 6 credit hours.
2. Minimum credit hours of course work should be 24 including minor subjects which shall not exceed one-third.
3. Minimum credit hours for the award of degree shall be 30.

MICR-601 Advanced Microbiological Techniques 3(2-2)

Learning Objectives:

Upon completion of this course, students will be able to:

- Understand how key microbiological methods work
- Work independently in microbiology research setups, pharmaceutical and food industry
- A practical command over molecular diagnostics/research techniques are integral part of this module

Theory

Application of Microscopy: bright field, dark field, fluorescent, phase contrast and electron microscopes. Isolation and identification of microbial pathogens by conventional methods. Evaluation of antimicrobial efficiency of commercially available antimicrobial agents (Antibiotics, antifungal agents), plant extracts and disinfectants.

Preparation of particulate antigen. preparation of soluble antigens; Isolation of bacterial and viral polypeptides in lab animal models; Characterization of subunits bacterial and viral antigens; Transformation of *E. coli* with recombinant plasmids; Southern blot; hybridization; Applications and protocols of different types of PCRs; Methods for DNA sequencing; Study of microbial proteins by SDS- PAGE method and western blotting.

Practical:

Bio-safety measures, Laboratory safety levels (1-4), Sterilization techniques. Isolation and identification of bacteria and fungi from different samples, use of microscopes, staining techniques. Biochemical tests, Enumeration of micro-organisms. Evaluation of antimicrobials and disinfectants. Isolation and identification of viruses and serological tests. Molecular characterization of bacterial, fungal and viral polypeptides . Subunits bacterial and viral antigens. Western immunoblotting, Southern blot, hybridization.

Suggested Readings:

1. Camille, L. and M. Simonet, 2012. Bacterial Pathogenesis: Molecular and Cellular Mechanisms. Caister Academic Press, UK.
2. Tortora, G. J., Funke, B. R. and Case, C. L. 2012. Study Guide for Microbiology: An Introduction. 11th edi. Benjamin-Cummings Publishing Company, U.S.A.
3. Bruce A McClane, 2010. Molecular Pathogenesis, 2nd Edition, Integrated medical sciences series.
4. David DBBS and Churchil., 2010. Diagnostic Immunohistochemistry, 2nd Edi, Livingstone publishers.
5. Talaro, K.P. and Talaro, A., 2009. Foundations in Microbiology, 3rd Edi. WCB/McGraw-Hill.

6. Alcamo, I. E., 2008. Fundamentals of Microbiology, 5th Ed. Benjamin/Cummings Publishing Company.
7. Baker, S., Khan, N., Nicklin, J. and Killington, R., 2006. Instant Notes in Microbiology, 3rd Ed edition, Taylor and Francis.
8. Black, J. G. 2005. Microbiology: Principles & Explorations, 6th edition, John Wiley and Sons, N.Y. U.S.A.
9. Cappuccino J.G. and N. Sherman, 2004. Microbiology: a laboratory manual. Pearson Education., NJ, USA.
10. Jawetz, E., 2000. Medical Microbiology. 21st Ed., Prentice-Hall IntI. Ltd., London, UK

MICR-602 Microbial Zoonoses 3(2-2)

Learning objectives:

Upon completion of this course, students will be able to:

- Understand the scope and concepts of public health microbiology.
- Have the knowledge of microbial diseases of public importance transmitted through water, food, dairy products, meat, eggs, vegetables, fruits, air etc.
- Apply the knowledge for control of microbial disease in the population. .

Theory:

Concept and classification of zoonoses; comprehensive description of etiology, host range, epidemiology, Transmission, pathogenesis diagnosis and management of zoonotic diseases. Bacteria of Zoonotic importance such as *Bacillus*, *Clostridium*, *Mycobacterium*, *Pseudomonas*, *Leptospira*, *Brucella*, *Campylobacter*, salmonella, yersinia, listeria, staphylococcus, streptococcus, *E. coli*, and *Vibrio* cat scratch disease, chlamydia, borrelia etc. : Detailed description of viral zoonoses: influenza, rabies, tickborne encephalitis, , entero, parvo, adeno, astro, calci and corona viruses, vector borne viruses viz. Japanese encephalitis, Kyasanur forest disease, ,Crimean-Congo haemorrhagic fever, dengue fever, West-Nile viruses, yellow fever, rift-valley fever, equine encephalitis, louping ill, and some rare and potential zoonotic viruses such as Newcastle, FMD and pox viruses, food-borne viruses viz. rota virus and Prions . Fungal zoonotic diseases: Candidiasis, dermatophytosis, blastomycosis, Aspergillosis, Histoplasmosis, Ring worm infections, coccidioidomycosis, cryptococcosis, Mycotoxicosis. Prevention and Control measures for microbial zoonoses with special reference to Veterinarian/ paraveterinary staff.

Practical:

Isolation and identification of zoonotic agents, Molecular diagnostic procedures of zoonotic diseases. Survey based study on important regional zoonotic outbreaks

Suggested Readings:

1. Burlage, R.S., 2011. Principles of Public Health Microbiology. Jones and Bartlett Learning, Canada.
2. Manwar, A. W. 2010. Air Microbiology: An environmental and Health Perspective. Cinnamontal Print and Publishers, GOA.
3. Spencer, J. F. T. and A. L. R. Spencer, 2010. Public Health Microbiology: Method and Protocols. Humana Press, Totowa, New Jersey.
4. Jay, J. M., M. J. Loessner, and D. A. Golden, 2005. Modern Food Microbiology. 7th. Ed. Springer Science Publishers, U.S.A.
5. Thapliyal DC. 1999. Diseases of Animals Transmissible to Man. International Book Distr.

MICR-603 Advanced General Microbiology 3(3-2)

Learning objectives:

Upon completion of this course, students will be able to:

- Describe in details the cell structure and function, effect of different stress conditions, antigenic characteristics, pathogenesis and laboratory diagnosis.
- Explain the methods of microorganism's control, e.g. chemotherapy & vaccines.
- Demonstrate practical skills in fundamental and advanced microbiological techniques.

Theory:

The Study of Prokaryotic and Eukaryotic cell structure and function. Microbial evolution, taxonomy and diversity. Microbial nutrition, growth and metabolism, Control of microorganisms by physical and chemical agents. Evolution of microbial biota, classification of pathogens based on RNA typing. Molecular principals of the physiological processes involved in the life cycle of prokaryotic microorganism. Biogeochemical cycling and introductory microbial ecology; Microbial interactions, interrelationship of DNA, RNA and protein biosynthesis, regulation of DNA and RNA, adaptation of pathogenic microorganism to environment. Bacterial evasion from host defense, the molecular mechanism of microbial colonization (biofilm formation) and induced host cell death. Bacterial resistance to antimicrobial peptides. The fungi, their general characteristics, classification, Morphology, cultural characteristics, identification and reproduction. Viruses , their characteristics and chemotherapy.

Practical:

Preparation and maintenance of culture media, selective enrichment and differential media preparation for isolation of fastidious pathogens. Culturing of microbes in different stress environments and isolation of mutant strains; evaluation of effects of new antimicrobial agents on cell structure by Transmission and scanning Electron Microscopy. Various Molecular techniques for detection and virulence study of microbial pathogenesis.

Suggested Readings:

1. Camille, L. and M. Simonet, 2012. Bacterial Pathogenesis: Molecular and Cellular Mechanisms. Caister Academic Press, UK.
2. Tortora, G. J., Funke, B. R. and Case, C. L. 2012. Study Guide for Microbiology: An Introduction. 11th edi. Benjamin-Cummings Publishing Company, U.S.A.
3. Bruce A McClane, 2010. Molecular Pathogenesis, 2nd Edition, Integrated medical sciences series.
4. Baker , S., Khan , N., Nicklin, J. and Killington, R., 2006. Instant Notes in Microbiology, 3rd Ed edition, Taylor and Francis.

5. Black, J. G. 2005. Microbiology: Principles & Explorations, 6th edition, John Wiley and Sons, N.Y. U.S.A.
6. Cappuccino J.G. and N. Sherman, 2004. Microbiology: a laboratory manual. Pearson Education., NJ, USA.
7. Jawetz, E., 2000. Medical Microbiology. 21st Ed., Prentice-Hall IntI. Ltd., London, U

MICR-604 Advanced Immunology 3(2-2)

Learning Objectives:

Upon completion of this course, students will be able to:

- Detailed knowledge of the cells and organs of the immune system, their organization and diversity, and their specialized functions at different anatomical locations.
- Understand cross talk of immune cell receptors and cytokines in cellular interactions and co-ordination of immunological mechanisms.
- The course explores how immune regulatory molecules can be designed/ manipulated for use in vaccines, immunotherapy of disease and selection of animals.

Theory:

General overview of immune system. Defense mechanisms against various bacterial, viral and fungal infections. Cells, organs and major components of Immune system; Non-specific immunity. Specific immunity. Passive immunity. (natural; artificial). Active immunity (natural and artificial). Characteristics of antibody and antigen. Mechanism of interaction of antigen and antibody. Mechanism of antibody synthesis, Structure of antibody; various phases of antibody production; factor influence antibody production. Mucosal immunity. Cellular immunity like T cell receptors; TCR/MHC interactions, APC roles in cell differentiation, memory cell, Specific cell-mediated cytotoxicity and functions of immune cells. Role of Cytokines in autoimmunity, Regulatory lymphocytes. Chemokines and inflammation, Immune tolerance. Immunodeficiency diseases, Animal models of immune deregulation. Body immune response in transplantation, Auto-immunization: mechanism of diseases caused by autoimmunization. Maternal (vertical immunity) immunization.

Practical:

Tests for phagocytosis; Serological Tests; Purification of antibodies; Serum preparation, agglutination, (indirect agglutination, haemagglutination and haemagglutination-inhibition), fluorescent antibody technique; purification of antibody; immunodiffusion test; complement fixation test; precipitation tests, preparation of sera and vaccines; Enzyme linked immunosorbant assay (ELISA). Tests for cell mediated (Erythrocyte Rossette formation, Leucocytic migration inhibition assay, Microphages migration inhibition assay and microphage function assay).and mucosal immune responses (GALT, BALT, ELI-Spot Assay, IGA capture ELISA) etc; Use of lab animals models in immunology;

Suggested Readings:

1. Michael D. 2010. Veterinary Immunology, Principals and Practice. 2nd ed, Menson Publishers, Bristle, UK.
2. Tizzard, I. R., 2009. Veterinary Immunology -An Introduction. 8th Ed., W. B. Saunders Co., London, UK.

3. Abbas, A. K., Lichtman, A. H. and Pillai, S. 2007. Cellular and Molecular Immunology, Elsevier Health Sciences, N.Y. USA.
4. Johnson, A. G. G., Ziegler, R. J., Lukasewycz, O. A. and Lukasewycz, O. A. 2007. Microbiology and Immunology: Board Review Series, Lippincot Williams and Wilkins, M.D.
5. Kuby, J., 2006. Immunology. 6th Ed., W.H. Freeman and Co., New York, USA.
6. Chen, E. R. and Kasturi, S. 2006. Deja Review: Microbiology and Immunology, McGraw-Hill Companies, N.Y.
7. Van Emon, V. M. 2006. Immunoassay and Other Bioanalytical Techniques, CRC Press, F.L.
8. Jawetz, Melnick, and Adelberg, 2001. Medical Microbiology. Geo F. Brooks, A. Stephen Morse, Janet Butel and Janet S. Butel. McGraw-Hill Companies. New Jersey, USA.

MICR-605 Advanced Bacteriology 3(2-2)

Learning Objectives:

Upon completion of this course, students will be able to:

- Learn the properties and technical cultural, morphological and molecular characteristics essential for the identification of Gram positive, Gram negative, aerobic and anaerobic bacteria.
- Gain understanding and awareness of anaerobic bacteria in infection, antibiotics resistance and their diagnosis.
- Apply the practical hands-on training in the characterization of specific bacterial species required for the fields of clinical microbiology and quality control in the major food, textile and pharmaceutical industries.

Theory:

Bacterial classification with reference to animals infections, environment and Antigenic structures and pathogenicity. Methods for isolation of potential pathogens from different environments (air, water and soil) including human and animal diseases, Introduction to anaerobic microbiology; Diversity and importance of anaerobic bacteria in diseases; Exploitation of anaerobic bacteria as probiotics ; Molecular diagnostic approach in bacterial infections; Principles of chemotherapy; Detailed characteristic studies and infections in animals caused by *Actinobacillus*; *Erysipelothrix* and *Listeria*; *Mycobacterium*; *Corynebacterium*; *Fusiformis*; *Pfeiferella*; *Vibrio*; *Neisseria*; Streptococci; *Staphylococci*; Coliform; *Proteus*; and *Klebsiella*; *Pseudomonas* and *Bacteroides*; *Salmonella*; *Pasteurella*; *Haemophilus*; *Bacillus*; *Brucella* and *Bordetella*; *Actinomyces*; *Clostridium*; *Fusobacterium*; *Veillonella*; *Bifidobacterium*; *Spirilla*; *Leptospira*, *Borrelia*, and *Trypanosoma*, *Ureaplasma* and *Mycoplasma*, *Rickettsia*, non spore forming anaerobes, miscellaneous potential pathogens.

Practical:

Personal safety and hazard in bacteriology Laboratory; while working and dealing with bacteria; Microscopy, Demonstration of isolation; purification and identification of bacterial spp. from various specimens collected from environment, water, soil, and animals etc; Preparation of different culture media for anaerobic bacteria, Cultivation methods/systems for anaerobes. . Quantifications of bacteria: turbidometry and estimation of bacterial population. Demonstration of latest molecular diagnostic techniques.

Suggested Readings:

1. Versalovic, J., 2011. Manual of Clinical Microbiology, 10th Ed. ASM Press.

2. Krieg, N.R., J. T. Staley, D. R. Brown, B. P. Hedlund, B. J. Paster, N. L. Ward, Wolfgang L and W.B. 2010. *Whitman Bergey's Manual of Systematic Bacteriology* 2nd Ed. Springer, New York USA.
3. Pearmain, T. H and C.G. Moor 2010. *Applied Bacteriology; an introductory Handbook*. Nabu Press. N.Y., USA.
4. Hawkey, P.M., Gillespie, S.H., Hawkey, P. 2006. *Principles & Practice of Clinical Bacteriology*. 2nd Ed. Wiley, John & Sons.
5. Garrity, G. M., 2005. *Bergey's Manual of Systemic Bacteriology*. 2nd Ed., Springer Publishers, USA.
6. Parker. M.T. and L.H. Collin. 2005. *Topley & Wilson's Principles of Bacteriology. Virology & Immunity*. 10th Ed., Edward Arnold, London.
7. Duerden, B. I. 2004, *Topley & Wilson's Microbiology and Microbial Infections, Volume 2: Systematic Bacteriology*. Hodder Arnold Publication New York
8. Sturuthers, J.K and R.P. Westran, 2003. *Clinical Bacteriology*. Manson Publishing Ltd Bristle, UK.
9. Collins, C.H., P. M. Lyne and J.M. Grange. 2004. *Microbiological Methods*. 8th Ed., Butter Worth Heinemann, Oxford.
10. Sharma, S.N. 1996. *Text Book of Veterinary Microbiology*. CBS Publications, Dehli.

MICR-606 Advanced Virology 3(3-2)

Learning Objectives:

Upon completion of this course, students will be able to:

- Understand structural and functional properties of all the important animal viruses
- Understand genetic mechanisms of virus replication and virulence
- Understand diagnostic techniques, mechanisms, treatment, prevention and control of viral disease

Theory:

Origin and nature of viruses; classification and basis of classification; size and morphology of virus particles; electron microscopy of virus particles. Techniques of isolation, purification and identification of viruses; serological properties of viruses; cultivation of viruses in chicken embryos, tissue culture and animal models. Virus multiplication and variation; Genome replication strategies; Virus-host interaction; Interference phenomenon, Interferon; Comparative bacterial virology; Bacteriophages; Classification of bacteriophages. Properties and growth pattern in temperate and lytic cycle; Bacteriophage bioinformatics and genomics. Bacteriophages in environment, food fermentation; Biotechnological and therapeutic role of bacteriophage. viral immunity; chemotherapy of viral infections. Viruses and Cancer; New and Emergent Viruses. Ds DNA viruses; ssDNA viruses; dsRNA viruses; positive-strand RNA viruses; negative-strand RNA viruses. Subviral Agents: Viruses without Genomes, Satellites and Viroids, Prions. Mechanism of antiviral drugs.

Practical:

Infectivity assay of animal viruses; cultivation of viruses in laboratory animals; use of avian embryo in virus cultivation; cultivation of viruses in cell cultures; cytopathogenesis of viruses. Plaque reduction test; the Reed Muench method for estimation fifty percent end point dilutions (LD 50 determination) serum-neutralization test; neutralization kinetics, haemagglutination, indirect haemagglutination and haemagglutination inhibition tests. FAT. Practicing biological containment. Identification of infectious agent through ELISA & PCR. Isolation and identification of Bacteriophages; Determination of one step growth curve.

Suggested Readings:

1. Bachmann, P.A., 2012. *New Developments in Diagnostic Virology*. Springer-Verlag New York, LLC
2. Stephenson, J.R., and Warnes, A., 2011. *Diagnostic Virology Protocols* Springer-Verlag New York, LLC
3. Alan J. Cann., 2010. *Principles of Molecular Virology*, 5th Ed. Elsevier Academic press, California, USA.
4. Leonard C. Norkin., 2010. *Virology: Molecular Biology and Pathogenesis*. ASM Press, Washington, DC, USA.

5. S. J. Flint, L. W. Enquist , V. R. Racaniello, A. M. Skalka, 2009. Principles of Virology: Molecular Biology, Pathogenesis, and Control of Animal Viruses. ASM Press, Washington, DC, USA.
6. Kudesia, G., 2009. Clinical and Diagnostic Virology. Cambridge University Press.Nicholas
7. Mahy, B.W.J.,& Van Regenmortel, M.H.V., 2008. Encyclopedia of Virology 3rd. Edition. Elsevier.
8. H. Acheson., 2007. Fundamentals of Molecular Virology, 1st Ed. John Wiley & Sons, Inc. Publ., New York, USA.

MICR-607 Advanced Mycology 3(2-2)

Learning Objectives:

Upon completion of this course, students will be able to:

- Identification of fungi, recognition of their unique features and properties. Fungal growth, nutrition and metabolism
- Understand major fungal diseases and their health and economic impacts
- Understand role of Fungi in the recent development of biotechnology

Theory:

General characteristics, identification, structure and classification fungi; Fungal nutritional requirements for growth; Fungal metabolism and fungal products including those obtained through fermentation and biotechnology. Fungal Ecology: Pathogenic fungi and their role in causation of superficial, deep seated and systemic diseases of livestock and poultry. Principles and the practice of controlling fungal growth. Antifungal drugs and their mechanism; Fungal genetics, molecular genetics and genomics. Role of fungi in Biotechnology. Myconanotechnology. Classification of mycotoxins. Structure and physico-chemical properties of mycotoxins. Mode of action / pathogenesis of mycotoxins. After effects of mycotoxicosis. Factors affecting production of mycotoxins: physico-chemical requirements. Techniques for production, detection and characterization of mycotoxins.

Practicals:

Demonstration of cultural characteristics, reproduction, identification and classification of the yeasts and molds of general and medical importance detailed above. Methods of preservation of fungi. Determination of anti fungal activity of substances. Molecular identification of fungi with special reference to disease diagnostic and treatment. Quantitation and detection of mycotoxins by various advance techniques. Freeze drying of mycotoxins.

Suggested Readings:

- 1 Caister Gioconda, S-B. and Richard, C. A., 2012. Pathogenic Fungi: Insights in Molecular Biology. Academic Press.
- 2 Katherine B., Daniel J. E, 2010. Cellular and Molecular Biology of Filamentous Fungi. ASM Press
- 3 Deacon, J. 2010. Fungal Biology. Blackwell Publishing, Oxford, UK.
- 4 Ainsworth, G.C., 2009. Overview: Introduction to the History of Mycology. Cambridge University Press.
- 5 Rai, M., P.D. Bridge, 2009. Applied Mycology. CAB International. Baltimore USA.
- 6 Anaissie, E.J., M.R. McGinnis and M.A. Pfaller. 2009. Clinical Mycology. 2nd Ed. Churchal Livingstone. Elsevier. New York USA.
- 7 Webster, J. and Weber, R. 2008. Introduction to Mycology, Cambridge University Press.

- 8 Hocking, A.D., Pitt, J.I., Samson, R.A., Thrane, U., 2006. *Advances in Food Mycology*, Springer-Verlag New York, LL.
- 9 Javed Aziz Awan and Sajjad-ur-Rahman. 2005. *Manual. of Microbiology* 2nd Edition Unitech Communication, Faisalabad. Pakistan.
- 10 Bilgrami, K.S. and R.N. Verma. 1981. *Physiology of fungi*. Vikas Publishing House Pvt. Ltd. Delhi, India.

MICR-608 Microbial Physiology 3(2-2)

Learning Objectives:

Upon completion of this course, students will be able to:

- Develop an understanding of the cellular and intracellular organization of the microbial cells.
- Understand how microbes transport major and minor nutrients for cellular growth and differentiation. Cell to cell communication and new insights into microbial pathogenesis.
- Key Enzymes and Metabolic pathways that enable microbes to grow and outcompete other organisms under a variety of favorable and adverse environmental conditions and used as tools in genetic engineering, biological transformations and a variety of industrial and environmental applications.

Theory:

Microbial Cell Structure and Function; Synthesis of DNA, RNA and Protein; Structural Assembly, Bacterial growth; Environmental effects; Enzymes and Energy Production; Physiological adaptation; Mutation and adaptation, Respiration and Fermentation. Gene expression, regulation and control, Microbial ecosystems. Microbial nutrition and growth, microbial metabolism, energy, enzymes, pathways and regulation , role of ATP in metabolism, Oxidation-Reduction reactions and electron carriers/control of enzymatic activity. Overview of metabolism. The breakdown of glucose to pyruvate. Fermentation reactions. anaerobic respiration, catabolism of carbohydrates and intracellular reserve polymers, lipid catabolism, protein and amino acid catabolism. Oxidation of inorganic molecules. The photosynthetic fixation of CO₂. The synthesis of sugars and polysaccharides. Assimilation of inorganic phosphorous, sulfur and Nitrogen. Anaplerotic reactions. The synthesis of purines, pyrimidines and nucleotides. lipid synthesis, peptidoglycan synthesis, pattern of cell wall formation) Microbial ecology & symbiosis: cell to cell communications (quorum sensing and quorum quenching). Symbiotic interactions, parasitism. Microbial evolution and biodiversity: Microbial infractions in extreme environments, microbes of the hydrothermal vent communities. Loss and maintenance of biodiversity.

Practical:

Microbial assays, General applications and their practical significance, Bacterial growth cycles and measurement of bacterial growth dynamics, analysis of microbial growth data, Nutrient limited growth and growth stimulation by nutrient supplementation, design and optimization of growth media.

Suggested Readings:

1. Poole, R.K., 2012. *Advances in microbial Physiology*. Book series. Elsevier Ltd.
2. Rathi. 2009. *Microbial Physiology genetics and Ecology*. MPDI.
3. Moat , A. G., Foster, J.W., Spector, M.P., 2009. *Microbial Physiology* 4th Ed. John Wiley & Sons. London, UK.
4. Seckbach, J., 2007. *Journey to Diverse Microbial Worlds Adaptation to Exotic Environments* .Publisher: Springer-Verlag New York.
5. Prescott, L.M., J.P. Hartley and D.A. Klein 2005. *Microbiology*, Sixth Edition. Mc Graw Hill International Boston, U.S.A., ISBN 607-122834-9.
6. Tortora, G.J., B.R. Funke, C.L. Case. 2001. *Microbiology, an Introduction*. 9th Edition. Benjamin Cummings (Pearson) Publishers, USA. ISBN-10: 0805375546.
7. Caldwell, D.R. 1999. *Microbial Physiology and Metabolism*. Star Publishing Company, ISBN: 0898632080.
8. Dawes, I.W. and I.W. Sutherland. 1992. *Microbial Physiology* 2nd Edition. Blackwell Scientific Publishers Ltd. London. ISBN: 0632024631.

MICR-609 Special Problem 1 (1-0)

Learning Objectives:

Upon completion of this course, students will be able to:

- Identify, review and plan to address the specific issues pertaining to microorganism
- The respective supervisor of the students will assign a topic of interest to make him understand the ways and means of addressing to microorganism

MICR-610 Seminar 1(1-0)

Learning Objectives:

Upon completion of this course students will be able to:

- Identify, review ,plan and orally present the specific issues pertaining to microbial disease
- The respective supervisor of the students will assign a topic of interest to make him understand the ways and means of addressing an issues pertaining to microorganism and present as a seminar

MICR -611 Dairy and Meat Microbiology 3(2-2)

Learning objectives:

Upon completion of this course, students will be able to:

- Analyze and differentiate the interrelationships of microorganisms with dairy animals and environment and their role in milk processing, milk product manufacture, milk spoilage, and milk safety
- Predict the impact of milk processes and milk handling on the microbiology of milk and milk products
- Develop advanced success skills including critical thinking, professionalism, and life-long learning

Theory:

Role of microorganisms in dairy and meat industry, dairy animal's health and dairy environment control. Bacteria, viruses, yeast and molds deterioration of raw, pasteurized, Ultra Heat Treated Milk, concentrated milk Pathogens in milk and milk products like milk powders, whey, butter, yoghurt, cheese, indigenous products, ice cream and frozen desserts; Starter cultures and their uses; Probiotics production and different Prebiotics effects on Probiotics efficiency; Advanced microbiological and molecular techniques for the examination of milk and milk products; Selective identification; Public health concerns; Microbes used in the preparation of various dairy products; Control of microorganisms involved in processing of dairy products. Dairy waste and treatment; Microbial spoilage and safety (shelf life) of dairy products; International Standard Microbiological quality assurance of dairy products. Determination of Food poisoning pathogens by molecular methods. International Standard Microbiological quality assurance of meat products. Microbial deterioration of meat and meat byproducts, frozen meat. Zoonotic diseases transmitted by consumption of meat and meat byproducts.

Practical:

Collection and transportation of samples of milk and milk products: Bacteria, yeast and molds isolations and characterization from different sources of Dairy and meat industry. Different conventional and molecular techniques. Somatic cell counts, coliforms, Mesophilic aerobic microorganisms: Microbiological assays for detection of aflatoxins and drugs residues in dairy, meat and their byproducts.

Suggested Readings:

1. Pommerville, J.C 2011 Alcamo's Fundamentals of Microbiology Jones and Bartlett Publisher International, London, UK.
2. Parihar, P. and L. Parihar, 2006. Dairy Microbiology. Bharat Printer Press, Jodhpur, India.

3. Pommerville, J.C and I. E.Alcamo. 2005. Alcamo's Laboratory Fundamentals of Microbiology. Jones and Bartlett Publisher International, London, UK
4. Robinson, R. K. 2002. Dairy microbiology handbook: microbiology of milk and milk products. 3rd Ed. John Wiley & Sons, New York .USA
5. Elmer, H. M. and J. L. Steele. 2001. Applied Dairy Microbiology, 2nd Ed. Marcel Dekker Inc. London, UK.

MICR-612 Bio-Safety and Risk Management 3(3-0)

Learning objectives:

Upon completion of this course, students will be able to:

- Learn safe practices for handling of microbes.
- Learn about risky and hazardous environment.
- Learn about the development of safe and healthy environment.

Theory

Various types of infectious materials: handling and methods of their disposal. Segregation of waste materials. Laboratory acquired infections: possible sources and causes. Hazardous groups of microorganisms including genetically modified organisms. Basic containment rules and laboratory containment levels. Guidelines for workers in Microbiology Labs. Rules for safe conduct of field work expeditions in outdoor activities. Risk assessment: recognition of hazards, competence, elimination of hazards, collection of data etc .Risk group personnel: their education, training and monitoring. Radiation hazards and disposal of radioactive wastes. Detailed concept of Risk and Hazardous Environment, Chemicals, Biological factors and Radiations. Risk assessment & Management: Preventions, Surveillance and Monitoring. Judicial rights / Penalties. Concepts of Biosafety Environment: Terrestrial, Marine, Atmosphere. Designing of labs based on Biosafety and Biological Containment parameters. Details of Biological Containment: Animals, Microbes. Bioethical issues related to Biosafety. Biosafety levels Identification of pathogens in infectious waste. Identification of hazardous chemical waste in water reservoirs. Applications of standard protocols for bio safety and risk management related issues.

Suggested Readings:

1. Callahan, R.J., 2012. Emerging Biological Threats: A Reference Guide. Greenwood Publishing Group, Incorporated.
2. US Health Department. 2010. Biosafety in Microbiological and Biomedical Laboratories 5th Ed. Books Express Publishing. U.S.A.
3. Miller, C.H., 2009. Infection Control and Management of Hazardous Materials for the Dental Team, 4th Ed. Elsevier Health Sciences.
4. Frosch, M., Martin C. and Maiden, J., 2006. Handbook of Meningococcal Disease: Infection Biology, Vaccination, Clinical Management. John Wiley & Sons, Inc U.S.A.
5. Fleming, D.O., and D.L. Hunt, D.L.2006. Biological Safety. Principles and Practices, 4th Ed. ASM Press, Washington, D.C.
6. Gillespie, S., and Hawkey, P. 2006. Principles and Practice of Clinical Bacteriology, 2nd Edition . John Wiley& Sons, Inc U.S.A.