

**REVISED CURRICULUM
OF
VETERINARY MICROBIOLOGY**

Curriculum Development Project
Sponsored by
Ministry of Science and Technology
Islamabad



UNIVERSITY GRANTS COMMISSION
H-9, ISLAMABAD
2001

CURRICULUM DIVISION, UGC

Prof. Dr. Altaf Ali G. Shaikh
Mr. Muhammad Javed Khan
Malik Ghulam Abbas
Miss Ghayyur Fatima
Mr. Zaheer Ahmad Awan

Director General (C&T)
Director Curriculum
Deputy Director
Research Associate
Education Officer

Composed by Ghafoor Ahmad, UGC, Regional Centre, Lahore

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PREFACE

Curriculum of a subject is said to be the throbbing pulse of a nation. By looking at the curriculum of a subject, one can judge the state of intellectual development and the state of progress of a nation. The world has turned into a global village, new ideas and information are pouring in a constant stream. It is, therefore, imperative to update our curricula by introducing the recent developments in the relevant fields of knowledge.

In exercise of the powers conferred by Sub-section (1) of section 3 of the Federal Supervision of Curricula Textbooks and Maintenance of Standards of Education Act 1976, the Federal Government vide Notification No.D773/76-JEA (Cur.), dated December 4, 1976, appointed University Grants Commission as the Competent Authority to look after the Curriculum Revision Work beyond Class XII at Bachelor level and onwards to all Degrees, Certificates and Diplomas awarded by Degree Colleges, Universities and other Institutions of higher education.

In pursuance of the above decisions and directives, the Commission is continually performing curriculum revision in collaboration with the Universities. According to the decision of the 44th Vice-Chancellors' Committee, curriculum of a subject must be reviewed after every 3 years. For the purpose, various Committees are constituted at the national level comprising senior teachers nominated by the Universities. Teachers from local degree colleges and experts from user organizations, where required, are also included in these Committees.

The Curriculum Revision Committee on Veterinary Microbiology in its meeting held in June, 2001 at the UGC, Regional Centre, Lahore finalized the draft curriculum after due consideration of the comments and suggestions received from the Universities and Colleges where the subject under consideration is taught.

The Final draft prepared by the Curriculum Revision Committee duly approved by competent authority is being circulated for implementation by the Universities.

(PROF. DR. ALTAF ALI G. SHAIKH)
ADVISER (C&T)

June, 2001

INTRODUCTION

A meeting of the National Curriculum Revision Committee for Veterinary Microbiology to finalize the draft syllabus prepared in its preliminary meeting was held on June 21-23, 2001 at UGC, Regional Centre, Lahore. The following attended the meeting:

1. Prof. Dr. M. Akram Munir
Department of Vet. Microbiology
College of Veterinary Sciences,
Lahore. Convener
2. Dr. Laique Ahmed Siddiqui
Chairman
Department of Veterinary Microbiology
Sindh Agriculture University,
Tandojam. Member
3. Prof. Dr. Muhammad Siddique
Department of Veterinary Microbiology
University of Agriculture,
Faisalabad. Member
4. Dr. M. Afzal,
CSO, Animal Sciences Division
Pakistan Agriculture Research Council,
P.O. NIH, Islamabad. Member
5. Dr. Mirza Ali Khan
Research Officer
Department of Microbiology,
Directorate of Veterinary Research Institute,
Government of NWFP,
Peshawar. Member
6. Dr. Abdul Salam Akhtar
Nominee of PVMC,
House No. 4, Street No.7,
Sector F-8/3, Islamabad. Member

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| 7. | Dr. Masood Rabbani
Assistant Professor
Department of Veterinary Microbiology,
College of Veterinary Sciences, Lahore. | Member |
| 8. | Dr. Saeedullah
Department of Veterinary Microbiology
Institute of Animal Husbandry and Vet. Sciences,
Gomal University, D.I. Khan | Member |
| 9. | Dr. Iftikhar Hussain
Associate Professor,
Department of Vet. Microbiology,
University of Agriculture, Faisalabad. | Member |
| 10. | Ms. Sumeera Akhtar
Lecturer,
Department of Microbiology,
College of Veterinary Sciences, Lahore. | Member |
| 11. | Dr. M. Safdar Anjum,
Assistant Professor,
University College of Agriculture,
Rawalakot, AJK. | Member/Secretary |

The meeting started with recitation from the Holy Quran by Dr. Laique Ahmed Siddiqui.

Mr. Muhammad Javed Khan, Director Curriculum, UGC, welcome the participants and briefed them of the obligations of the Commission for review, revision and development of curricula beyond class-XII as per provisions of the Act of Parliament, 1976. He suggested the committee to go through the draft curriculum of Veterinary Microbiology which forms an integral part of scheme of study for DVM, a specialization at MSc (Hons.) and PhD degrees and review the same in light of comments and suggestions as received from different universities/institutions and finalize its recommendations to make it available to universities before 30th June, 2001. He stated that the objectives behind the whole exercise of reviewing Vet. Sciences curricula to **inculcate the latest knowledge** amongst the future graduates in the field of Veterinary Microbiology which occupies a

very important position and study of which helps in the productivity and welfare of livestock, poultry and pet animals. The Director informed the members that the present exercise of curriculum revision for Agriculture, Basic Sciences, Applied Sciences, Engineering and Technology, Animal Husbandry and Veterinary Sciences is being carried out with the financial support of Ministry of Science and Technology.

Prof. Dr. Altaf Ali G. Shaikh, Adviser (Curriculum and Training) introduced the members of the committee of the different academic programmes of the commission aimed at enhancing the academic capabilities of in-service university/ college teachers. He suggested to the members to devise the minimum baseline curriculum which every university/college imparting education in this economically important sector should offer. He emphasized inclusion of latest books in the list of suggested readings so that new concepts and ideas are imparted to the future graduates.

After opening remarks by the Director Curriculum and the Adviser (C&T) the committee took up regular agenda. Prof. Dr. M. Akram Munir was unanimously appointed as convener and Dr. M. Safdar Anjum as Secretary of the Committee.

The Convener briefed the committee of the percentage of Animal Husbandry and Veterinary Science courses in a composite DVM degree programme offered at Sindh Agriculture University, Tandojam v/v that offered at other Universities/ institutions which have relatively lower weightage for animal husbandry courses and more emphasis on veterinary sciences. It was, however, felt that the problem of two sets of the systems of Veterinary Education be resolved at national level and if it is not possible the courses of study for DVM degree be so adjusted so as to contain reasonable percentage of courses on animal production. Likewise the duration of the degree programme may also be adjusted if deemed necessary. The contents of enclosed syllabi need to be taught to a professional veterinary graduate, however, every university/institutions may teach the syllabi under any title and number of credit hours. After deliberating the problem at length, it was agreed to recommend the syllabus, which in opinion of the committee may form minimal baseline and latest available books be added for imparting the latest knowledge amongst the students.

The committee after discussing the existing curricula of Vet. Microbiology at graduate and postgraduate levels, agreed to the uniform draft curricula as detailed in the next pages:

**SCHEME OF STUDIES
OF
VETERINARY MICROBIOLOGY FOR DVM**

Title of the Courses

General Microbiology and Immunology

Systematic Bacteriology and Mycology

General Virology

Systematic Virology

Veterinary Epidemiology

Animal Food Hygiene

Poultry Health Monitoring

DETAIL OF COURSES

GENERAL MICROBIOLOGY AND IMMUNOLOGY

Theory

a) General Microbiology

Introduction to Microbiology: Definition and branches of Microbiology, historical introduction including work of Pasteur, Koch, Lister and recent developments. Prokaryotes vs eukaryotes.

Bacterial morphology: Shape, size, arrangement and differential staining. General plan of the bacterial cell; nuclear apparatus, bacterial cytoplasm, intracellular granules; cell wall and membrane, capsule, endospore, flagella, fimbriae or pili, protoplast, spheroplast, L-forms, etc.

Bacterial Growth and Multiplication: Physico-chemical requirements; pH, temperature, oxidation reduction potential, gaseous and nutritional requirements, etc. Types of culture media; Bacterial multiplication and growth curves, continuous culture. Bacterial preservation.

Bacterial genetics: Mutation and mutagenesis: transposons, conjugation, transformation, transduction, plasmids and their importance, lysogeny, introduction to genetic engineering.

Fungi: Introduction to fungi, moulds and yeasts, growth requirements and modes of replication.

b) Immunology

Introduction to immunity. Innate (non specific) immunity: natural barriers of defense, phagocytes and complement system, etc. Acquired immunity; types, immune responses.

Antigens and antigenicity: Essential features of antigens, epitope, cross-reactivity, macrophage and antigen processing and presentation, other antigen presenting cells, fate of foreign materials within the body.

Cells and organs of the immune system (birds and animals): B and T lymphocytes, cell interactions, immuno-regulators, regulation of immune

system, immune tolerance. Major histocompatibility complex (MHC): MHC of domestic animals.

Immunoglobulins: Structure, isotypes, theories of antibody formation, monoclonal antibodies and hybridomas, immunoglobulins of domestic animals.

Complement system: Classical and alternative complement pathways.

Hypersensitivity: Types and mechanisms with examples of veterinary importance.

Vaccines and vaccination; Types of immunization procedures, methods of vaccine production, vaccine administration, adverse consequences of vaccination.

Immunomodulations: Suppression of immune system, immunostimulants and immunopotentiators, adjuvants. Autoimmunity and autoimmune diseases.

Practical

Safety in the microbiological laboratory, demonstration of laboratory equipments, their basic functions and handling.

Microscope and microscopy: Bright field, dark field, phase contrast, fluorescent, etc.

Sterilization and disinfection: Physical agents including moist heat, dry heat, ionizing radiation, filtration, etc. Chemical agents including types, factors influencing activity, evaluation of antimicrobial activity (phenol coefficient).

Bacteriological media: Preparation and demonstration of various culture media: (basic, enriched, selective, differential, enrichment, transport and storage media).

Stains and staining: Simple (Loeffler's methylene blue staining, differential (Gram's and acid fast), special (flagella, capsule, spores, etc.)

Methods of bacterial cultivation and growth.

Bacterial colonies: Types and characteristics.

Morphology: Shape and arrangement, micrometry and motility.

Antibiotic sensitivity testing.

Methods of antigen and hyperimmune sera preparation.

Demonstration of sero-diagnostic methods like precipitation and agglutination.

Demonstration of delayed hypersensitivity testing.

Books recommended

1. Jawetz, E., 2000. Medical Microbiology 21th Ed, Prentice-Hall Intl, Ltd., London.
2. Dawes, I.W. and I. W. Sutherland. 1999. Microbial Physiology. 2nd Ed., Blackwell Scientific Publ., Philadelphia.
3. Tizzard, I.R. 1999. An Introduction to Veterinary Immunology. W.B. Saunders Co., London.
4. Khushi, M., A.R. Rizvi and M. Siddique, 1998. Manual of General Microbiology, University of Agriculture, Faisalabad.
5. Tortora, G.J., B.R. Funke and C.L. Case. 1997. Microbiology - An Introduction. 6th Ed., Addison and Wesley Longman Inc., California.
6. Virella, G. 1997. Microbiology and Infectious Diseases. 3rd Ed., Williams and Wilkins. Baltimore.
7. Cappuccino, J.G. and N. Sherman. 1996. Microbiology - A Laboratory Manual. 4th Ed. Benjamin/Cum Publ. Co., California.
8. Talaro, K. and A. Talaro. 1996. Foundation in Microbiology. 2nd Ed. Win C. Brown Publ., Iowa.
9. Vollum, R.L., D.G. Jamison and C.S. Cummins. 1994. Fairbrother's Textbook of Bacteriology 13th Ed. William Heinemann Medical Books Ltd., London

SYSTEMATIC BACTERIOLOGY AND MYCOLOGY

Theory

a) Bacteriology

An overview of classification and nomenclature of bacteria.

Morphology, cultural characteristics, biochemical activities, resistance to physico-chemical agents, antigenic properties, toxins, association with animal diseases, diagnosis and immuno-prophylaxis for the following genera/groups:

Aerobic G+ve cocci; Streptococcus (equi, pyogenes, agalactiae, dysgalactiae, faecalis, pneumoniae, uberis, etc). Staphylococcus (aureus, intermedius, hycus, etc.), etc.

Facultative anaerobic G-ve rods: Escherichia coli, Salmonella (gallinarum, pullorum, dublin, typhimurium, enteritidis, abortus, equi, etc.), Shigella, Proteus, Klebsiella, Enterobacter, Yersinia, Vibrio, Pasteurella (multocida, hemolytica), Haemophilus (paragallinarum, etc.), etc.

Aerobic non-spore forming G+ve rods: Corynebacterium (diphtheriae, bovis, ovis, equi, renale, pyogenes), Listeria monocytogenes. Erysipelothrix incidirosa.

Acid-fast bacteria: Mycobacterium (tuberculosis, bovis, avium and murium), M. johnei, M. leprae and atypical mycobacteria, Nocardia.

Aerobic and anaerobic G+ve sporeforming rods: Bacillus anthracis and anthracoides, Clostridium (tetani, botulinum, oedematiens, septicum, chauvoei, welchii, etc.) Dermatophilus congolenses, etc.

Anaerobic G-ve rods: Bacteriodes, fusobacterium,

Actinomycetes: Actinomyces bovis, etc.

Aerobic and Anaerobic spirochaetes: Borrelia anserina, Leptospira (canicola, pomona, icterohaemorrhagiae, etc). Treponema and Spirillum species.

Aerobic/Microaerophilic G-ve helical rods: Campylobacter (foetus, venerealis, intestinalis, bubulas, jejuni, coli), etc.

Aerobic G-ve rods and cocci: *Actinobacillus lignieresii*, *Brucella* (*abortus*, *melitensis suis*, *ovis*, *canis*), *Francisella tularensis*. *Moraxella*. *Pseudomonas* (*aeruginosa*, *mallei*, *pseudomallei*), *Bordetella*. Chlamydial diseases in animals.

Aerobic cell wall free bacteria: *Mycoplasma* (*mycoides*, *bovigenitalium*, *capri*, *agalactiae*, *argini*, *canis*, *gallisepticum*, *synoviae*, *maleagridis*, etc.). *Acholeplasma*, *Ureaplasma*, etc.

b) Mycology

An overview of classification of fungi.

General characteristics, natural habitat, disease association and laboratory diagnosis of the following:

Dermatophytes: *Trichophyton*, *Microsporum*, *Epidermophyton*.

Pathogenic yeasts: *Candida*, *Trichosporum*, Dimorphic fungi; *Sporothrix*, *Blastomyces*, *Histoplasma*, *Coccidioides*, etc.

Zygomycetes: *Absidia*, *Mucor*, *Rhizopus*, etc.

Mycotoxins and mycotoxicoses: General features, mycotoxin formation, characteristics of mycotoxins, mycotoxicosis including aflatoxicosis, fusarium toxicosis, ochratoxicosis, etc.

Practical

Collection, preservation and submission of material/samples for laboratory diagnosis of bacterial and mycotic infections.

Specimen selection, direct microscopy, isolation, identification (colony characteristics, biochemical tests), antibiotic sensitivity test, serological tests and animal inoculation tests of the following:

Streptococcus, *Staphylococcus*, *Escherichia*, *Salmonella*, *Proteus*, *Corynebacterium*, *Listeria*, *Mycobacterium*, *Bacillus*, *Clostridium*, *Leptospira*, *Campylobacter*, *Mycoplasma*, *Brucella*, *Pasteurella*, *Pseudomonas*, etc.

Isolation and identification of common fungi contaminants and dermatophytes.

Preparation and evaluation of bacterins, toxoids, etc.

A study tour to a Diagnostic Lab./Research Institute.

Books Recommended

1. Jawetz, E. 2000. Medical Microbiology, 21st Ed. Prentice Hall Ltd. London.
2. Anonymous, 1999. A Laboratory Manual for the Isolation and Identification of Avian Pathogens, 6th Ed. American Association of Avian Pathologists, Iowa State University Press, Ames., Iowa.
3. Buchanan, R. E. and Others (Eds). 1999. Bergey's Manual of Systematic Bacteriology. Williams and Wilkens, Baltimore.
4. Cappuccino, J.G. and N. Sherman. 1996. Microbiology - A Laboratory Manual. 4th Ed. Benjamin/Cum Publ. Co., California.
5. Quinn, P.J., M.E. Carter, B.K. Markey and G.R. Carter. 1990. Clinical Veterinary Microbiology, Wolf, London.
6. Carter G.R. and J.R. Cole Jr. 1990. Diagnostic Procedures in Veterinary Bacteriology and Mycology. 5th Ed., Academic Press, New York.
7. Merchant, I.A. and R.A. Packer. 1984. Veterinary Bacteriology and Virology. 7th Ed., Iowa State University Press, Ames, Iowa.

GENERAL VIROLOGY

Theory

Fundamental characteristics of viruses: Definition and history of virology; general properties of viruses; methods for studying viruses; purification of viruses; determination of particle size. Virus classification.

Virus replication: adsorption-receptors/ligand, entry, mechanisms, uncoating, biosynthesis of virus components-transcription and translation, assembly, release, replication of RNA, DNA and oncogenic viruses, defective viruses.

Properties of animal viruses at cellular level: infection of cell with more than one virus; recombination (reassortment); exaltation, dormancy

and reactivation; interference, mechanisms of haemagglutination, haemadsorption and elution.

Interferon: properties, types, mode of action, biological significance, antibodies vs interferons, antiviral agents. Factors affecting success and failure of viral vaccines.

Introduction to bacteriophages and its typing.

Practical

An introduction to equipments used in virological work.

Collection, storage and preparation of sample for virus studies.

Purification and concentration of virus (ultracentrifugation, precipitation and ultrafiltration).

Cultivation of viruses; animal inoculation, embryonated egg inoculation, cell culture preparation and inoculation, demonstration of cytopathic effects (CPE).

Virus identification methods: Electron microscopy, HA, precipitation, HI, IHA, ELISA, FAT, haemadsorption and VN tests. Demonstration of electron micrographs of various viruses.

Demonstration of preparation of viral antigen.

Virus titration; determination of LD50, ID50, EID50, CCID50

Preservation and storage of viruses (low temperature, freeze drying, etc.).

Visit to a research institute.

Books Recommended

1. Rabbani, M. and M. A. Muneer. 2001. Techniques in Virology, 1st Ed., College of Veterinary Sciences, (University of Agriculture), Lahore.
2. Virella, G. 1997. Microbiology and Infectious Diseases. 3rd Ed., Williams and Wilkins, Baltimore.
3. Talaro, K. and A. Talaro. 1996. Foundation in Microbiology. 2nd Ed. Win C. Brown Publ., Iowa.

4. Fenner, F.J., E.P. Gibbs, F.A. Murphy, M.J. Studdert and D.O. White. 1993. *Veterinary Virology*. 2nd Ed., Academic Press, London.
5. Burleson, F.G., M.T. Chanbes and D.Wioedbrnk. 1992. *Virology – A Laboratory Manual*, Academic Press, London.
6. Franckie, R.I.B., C.M. Fauquel, D.L. Knudson, and F. Brown. 1991. *Classification and Nomenclature of Viruses*, Report of International Committee on Taxonomy of Viruses, Springer-Verlag Wien., New York

SYSTEMATIC VIROLOGY

Theory

Description including morphology, cultivation, physico-chemical characteristics, isolation and identification, immunity and disease association of following (RNA/DNA) viruses:

Orthomyxoviridae: influenza type A, B and C.

Paramyxoviridae: Newcastle disease virus, Parainfluenza virus, Mumps virus, Measles virus, Canine distemper virus, Rinderpest virus, PPR virus, Respiratory syncytial virus.

Rhabdoviridae: Vesicular stomatitis virus, Rabies virus, Bovine ephemeral fever virus, infectious hematopoietic virus, Spring viremia of carp, etc.

Filoviridae: Ebola virus, etc.

Caliciviridae: Vesicular exanthema virus, Feline calici virus.

Picornaviridae: Foot and mouth disease virus, Simian and bovine enteroviruses, Avian encephalitis virus, Human, bovine and equine rhinovirus, etc.

Birnaviridae: Infectious pancreatic necrosis virus, infectious bursal disease virus, etc.

Reoviridae: Reovirus of mammals/birds, African horse sickness virus, Blue tongue virus, Epizootic haemorrhagic disease virus of deer; Rota viruses, etc.

Toroviridae: Breda virus, Berne virus.

Togaviridae: BVD, Western, Eastern and Venezuelan equine encephalitis viruses, Sindbis virus, Equine arteritis virus, Swine fever virus, etc.

Retroviridae: Feline leukaemia virus, Avian leukosis virus, Simian virus, Sheep pulmonary adenomatosis virus, Human immunodeficiency virus (HIV), Visna virus, Caprine arthritis-encephalitis virus, Equine infectious anemia virus, Bovine immunodeficiency virus, etc.

Coronaviridae: Avian infectious bronchitis virus, Transmissible gastroenteritis virus, Haemagglutinating encephalomyelitis virus, Feline infectious peritonitis virus, Canine corona virus, bovine corona virus, etc.

Arenaviridae: Lymphocytic choriomeningitis (LMC) virus, Lassa fever virus.

Bunyaviridae: Akabane virus, Crimean-Congo haemorrhagic fever virus, Nairobi sheep disease virus, Rift valley fever virus, etc.

Flaviviridae: Yellow fever virus, Dengue haemorrhagic fever virus, Simian haemorrhagic fever virus, etc.

Poxviridae: Vaccinia virus, Monkeypox virus, Cowpox virus, Infectious ectromelia virus, Camelpox virus, Taterapox virus, Usin Gishu disease virus, Orf virus, Pseudocowpox virus, Bovine papular stomatitis virus, Sheeppox virus, Goatpox virus, Lumpy skin disease virus. Fowlpox virus, Myxoma virus, Rabbit fibroma virus, etc.

Herpesviridae: Pseudorabies virus, feline rhinotracheitis virus, Avian infectious laryngotracheitis virus, Herpes simplex virus, Varicella zoster virus, Infectious bovine rhinotracheitis virus, African malignant catarrhal fever virus, Marek's disease virus. Equine herpes virus, etc.

Adenoviridae: Human, Simian, Bovine, Ovine, Canine and Equine adenoviruses. Avian adenoviruses (CELO virus, IBHV, HPS, Egg drop syndrome virus, Haemorrhagic enteritis virus of turkey, etc).

Hepadnaviridae: Infectious canine hepatitis virus, etc.

Iridoviridae.

Circoviridae.

Papovaviridae: Papilloma and polyoma viruses.

Parvoviridae: Human, Bovine, Canine, Equine and Avian, parvoviruses, Feline panleukopenia virus. Adeno associated viruses of bovine, canine, avian, equine and ovine.

Unclassified group: African swine fever virus.

Prions and Viroids: Prions (Proteinacious infectious particles); Scrapie, bovine and other spongiform encephalopathies, viroids. Rickettsia

Practical

Collection and transportation of morbid material. Preparation of sample for virus isolation/cultivation.

General sketch for isolation and identification of viruses from diseased animals.

Source of sample, sample collection, virus cultivation, EM and sero-characterization of atleast following viruses of veterinary importance:

ND virus, canine parvo virus, FMD virus, sheep pox virus, etc.

Preparation and evaluation of live and inactivated virus vaccines (e.g. NDV).

Visit to diagnostic laboratory/research institute.

Books Recommended

1. Rabbani, M. and M. A. Muneer. 2001. Techniques in Virology, 1st Ed., College of Veterinary Sciences, (University of Agriculture), Lahore.
2. Anonymous, 1999. A Laboratory Manual for the Isolation and Identification of Avian Pathogens, 6th Ed. American Association of Avian Pathologists, Iowa State University Press, Ames., Iowa.
3. OIE. 1999. Manual of Standards for Diagnostic Tests and Vaccines. Off. Intl. des Epiz., Paris.
4. Quinn, P.J., M.E. Carter, B.K. Markie and G.R. Carter. 1994. Clinical Veterinary Microbiology. Wolf, London.
5. Fenner, F.J., E.P. Gibs, R. Roitt, M.S. Studders and D.O. White. 1993. Veterinary Virology, 2nd Ed Academic Press, London.

6. Burleson, F.G., T. M. Chanbes and D.I. Wiedrank. 1992. Virology - A Laboratory Manual, Academic Press, London.
7. Castro, A.E. and W.P. Henschele. 1992. Veterinary Diagnostic Virology. Mosby Year Book Inc., Baltimore.

VETERINARY EPIDEMIOLOGY

Theory

General concepts of epidemiology: Definitions and uses of epidemiology. Population and its types, Koch's and Evan's postulates for cause of disease. Variables and types of association. Causal models and formulation of causal hypothesis. Measures of disease occurrence like prevalence, incidence, mortality rate, case fatality rate and attack rate. Temporal and spatial distribution of disease.

Determinants of disease: Classification of determinants associated with host, agent and environment and their interaction.

Identification of disease determinants: Definitions, Surveys, Types and size of sampling. Epidemiological Studies: Cross-sectional, case control and cohort studies.

Sources and transmission of infection: Horizontal transmission, vertical transmission. Maintenance of infection.

Animal Health economics and productivity schemes: Value of economic analysis, Structure of health and productivity schemes. Dairy health productivity scheme.

Epidemiological data and various statistical methods: Sources of data, representation (coding) of data. Computerized and non computerized recording techniques. Epidemiological information on livestock/poultry diseases in the country.

Types of epidemiological investigation: Descriptive, analytical, experimental, clinical, sero-epidemiological and molecular.

Evaluation of diagnostic tests: specificity, sensitivity, efficacy, etc.

Control of Animal diseases: Definition of control and eradication. Herd infection and immunity; heterogeneity of herds at risk, control of

infection, concept of disease free zones, OIE pathways for freedom from disease.

Books Recommended

1. Blaha, T. 1999. Applied Veterinary Epidemiology. Elsevier Sci. Publ., London.
2. OIE. 1999. Manual of Standards for Diagnostic Tests and Vaccines. Off. Intl. des Epiz., Paris.
3. Thrushfield, M. 1996. Veterinary Epidemiology, Butterworth & Co. Ltd., London.
4. Schulte, P.A. and F.P. Perera. 1993. Molecular Epidemiology: Principles and Practices, Academic Press, California.
5. Knapp R.G. and M.C. Miller. 1992. Clinical Epidemiology and Biostatistics. National Medical Series, Williams and Wilkins, Baltimore.
6. Wayne, M.S., A.H. Meek and P. Willegerg. 1992. Veterinary Epidemiology - Principles and Methods. Iowa State University Press, Ames., Iowa.

ANIMAL FOOD HYGIENE

Theory

Milk and milk by-products hygiene: Types of bacteria in milk, bacteriological grading of milk, Infections (animal and human pathogens transmitted through milk), and intoxications associated with milk, Adulteration of milk, Measures to control the milk-borne diseases. Methods of increasing safety of milk supply (pasteurization, sterilization (UHT) and preservation of milk), Quality control of dried milk. Infection and intoxication associated with cream, yoghurt and cheese. Defects and spoilage of cheese.

Water, air and sewage hygiene: Environmental hygiene of air, water and sewage. Bacteriological analysis of water, plate count and coliform count. Water-borne diseases.

Meat, Fish, Shellfish and Eggs/Egg products hygiene: Diseases transmitted through meat, fish, shellfish, eggs, etc. Principles of serodiagnostic tests for identification of meat of different animal species.

Zoonosis: Direct zoonosis, cyclozoonoses, metazoonosis, saprozoonoses etc., important diseases and their significance.

Residues of drugs and pesticides in milk, meat, fish, shellfish, eggs and their effect on human health. World Trade Organization and its different agreements relating to import of different animals and their products.

Practical

Collection, transportation of samples of milk, meat, water, eggs/egg products and air for bacterial isolation.

Schematic sketch for isolation and characterization of bacteria from the samples.

Isolation and identification of the pathogenic organisms from experimentally contaminated eggs, meat, fish and milk samples.

Bacteriological examination of water and milk. Qualitative and quantitative methods. (most probable number (MPN), plate count, coliform count, confirmed and completed tests, resazurine methylene blue reduction test).

Sero-characterization of meat of different animal species.

Visit to a milk industry/ plant and a modern slaughter house.

Books Recommended

1. Frazier, W.C. 1995. Food Microbiology. 5th Ed. McGraw Hill Intl Co., New York.
2. Rheinheimer, G. 1994. Aquatic Microbiology, 4th Ed. John Wiley & Sons, New York.
3. Yadav, E.J.S. 1993. Comprehensive Dairy Microbiology, Saunders Book Co., Philadelphia.

4. Corry, J.E.L., D. Roberts and F.A. Skinner, 1992. Isolation and Identification of Food Poisoning Organisms. Academic Press Inc., London.
5. Woolcock. J.B. 1991. Microbiology of Animals and Animal products. World Animal Science. New York.

POULTRY HEALTH MONITORING

Practical

Strategies for tackling the poultry disease outbreaks.

Diagnosing a poultry outbreak.

Identification of source of infection.

Devising methods for the control of poultry diseases.

Vaccination and sero-monitoring.

Hatchery hygiene monitoring.

Biosecurity.

Visit to afflicted poultry farms for disease investigation and control in the face of an outbreak.

Books Recommended

1. OIE 1999. Manual of Standards of Diagnostic Tests and Vaccines. Office International des Epizooties, Paris.
2. Calnek, B.W., H.J. Barnes, C.W. Beard, W.M. Reid and H.W. Yoder, 1998. Diseases of Poultry, 10th Ed. Wolf Pub. Co., Ltd., London.
3. Jordan, F. T. W. and M. Pattison. 1996. Poultry Diseases. 4th Ed. W.B. Sanders Co. Ltd., London.
4. Quinn P.J, M.E. Carter, B.K. Markey and G.R. Carter. 1995. Clinical Veterinary Microbiology. Wolfe Publ. Co., Ltd., London.

**SCHEME OF STUDIES
FOR
POST GRADUATE COURSES**

Title of Course

Advanced General Bacteriology
Advanced Immunology
Advanced Systemic Bacteriology
Advanced Virology
Mycology
Microbial Physiology
Cell Culture Techniques
Oncogenic Viruses
Molecular Biology of Bacterial Viruses
Advanced Anaerobiology
Advanced Spirochaetology
Immunological Techniques
Techniques in Molecular Biology
Advanced Veterinary Epidemiology
Vaccines and Vaccinology
Introduction to Microbial Genetics
Avian Immunology
Advanced Readings in Immunology
Advanced Readings in Bacteriology
Advanced Readings in Virology
Advanced Readings in Mycology

MINOR, DEFFICIENCY AND REFRESHER COURSES

MINOR, DEFICIENCY AND REFRESHER COURSES

Microbiological Techniques
Postraduate Refresher Course in Bacteriology, Virology, Immunology & Epizootiology

DETAIL OF COURSES

ADVANCED GENERAL BACTERIOLOGY

Theory

Microscopy: Light, dark field, fluorescent, polarizing, phase contrast and electron microscopes.

Taxonomy of Bacteria: Basis of taxonomy, taxonomy of bacteria, origin and evolution of bacteria, species concept in bacteria.

Dyes and Staining: Light and colour, absorption spectrometry, general chemistry of dyes, indicators, nature of staining processes, factors influencing staining, staining of living cells, determination of isoelectric points of cell structure by staining, differential and special stains.

Structure of Eubacteria: Slime layer, cell wall, protoplast, cytoplasmic membrane, cytoplasm, cytoplasmic inclusions and vacuoles, the nucleus, flagella, fimbriae, the bacterial endospores, cytoplasm.

Growth requirements of bacteria: Bacterial nutrition and other requirements, physical factors affecting bacteria growth like surface tension; osmotic concentration, sonic energy; biofilms; radiation; temperature, mechanism of death caused by heating; heat in-activation of bacterial endospores.

Bacterial genetics: Genetic analysis, transfer of genetic material, mutations and mutagenesis, genetic variation.

Chemotherapy of bacterial infections.

Quantifications of bacteria: Turbidometry and estimation of bacterial population.

Practical

Quantification of bacteria.

Minimal inhibitory concentration (MIC) and related antibiotic testing procedures.

Tests for carcinogenesis (Ames test, Devoret's test, etc.).

Bacterial transformation test (Griffith experiment).

Induction and selection of bacterial mutants.

Tests for estimation of bacterial nutrition, using defined media, etc.

Induction of spore formation.

Book Recommended

1. Collins, C.H., P. M. Lyne and J.M. Grange. 2000. Microbiological Methods. 8th Ed., Butter Worth Heinemann, Oxford.
2. Jawetz, E. and W. Levinson. 2000. Medical Microbiology and Immunology. 5th Ed., Prentice Hall Ltd., London.
3. Parker. M.T. and L.H. Collin. 1998. Topley and Wilson's Principles of Bacteriology. Virology & Immunity. 9th ed., Edward Arnold, London.
4. Schaechter, M., G. Medoff and D. Schlessinger. 1997. Mechanism of Microbial Diseases. Williams and Wilkins, Baltimore.
5. Madigon, M.T., A.J. M. Martinko and J. Parker. 1997. Biology of Microorganism. 8th Ed. Prentice Hall Intl., New York.
6. Talaro, K. and A. Talaro. 1996. Foundation in Microbiology. 2nd Ed. Win C. Brown Publ., California.
7. Cappuccino, J.G. and N. Sherman. 1996. Microbiology - A Laboratory Manual. 4th Ed., Benjamin/Cum Publ. Co., California.
8. Malik, B. S. 1992. A Laboratory Mannual of Veterinary Bacteriology, Mycology and Immunology, 3rd Ed., CBS Publ., Delhi.
9. Lois, B. 1991. Microbiology in Practice. 5th Ed. Harper Collian Publication Inc., New York.

ADVANCED IMMUNOLOGY

Theory

Overview of immune system

Phagocytosis.

Complement system.

Hybridoma and monoclonal antibodies
Organization and expression of immunoglobulin genes.
Major histocompatibility complex
Antigen (processing and presentation)
B and T cell differentiation and maturation, B and T cell receptors
Immunoregulation and tolerance.
Autoimmunity.
Immunodeficiency diseases.
Transplantation
Tumor immunology.
Induction of mucosal immunity

Practical

Tests for phagocytosis
Determination of immunocompetence (cellular and humoral)
Isolation of B and T cells
Serological Tests
Purification of antibodies.

Books Recommended

1. Jawetz. E. and W. Levinson. 2000. Medical Microbiology and Immunology. 6th Ed., Prentice Hall, London.
2. Tizzard, I. 1999. Veterinary Immunology - An Introduction, 6th Ed., W.B. Saunders Co., London.
3. Elgert, K.D. 1996. Immunology: Understanding the Immune System. John Wiley & Sons Inc. Publ., New York.
4. Kuby, J. 1996. Immunology. 2nd Ed. W.H. Freeman and Co., New York.

5. Gershwin, L.J., S. Krakowka and R.G. Olsen. 1994. Veterinary Immunology and Immunopathology, 2nd Ed., Mosby, Saint Louis, Missouri.
6. Abbas, A.K., H.L. Andrew and S.P. Jordan. 1991. Cellular and Molecular Immunology. W.B. Saunders Co., London.
7. Lewis, R.M. and C.A. Picat. 1989. Veterinary Clinical Immunology. Lea & Febiger, Philadelphia.
8. Roitt, I.M. 1988. Essential Immunology, 6th Ed., ELBS/Blackwell Scientific Pub., London.

ADVANCED SYSTEMATIC BACTERIOLOGY

Theory

Methods of obtaining pure cultures, morphology, staining reactions, cultural characteristics, resistance, biochemical properties, antigenic structures and pathogenicity of following groups:

Actinobacillus, Listeria, Mycobacterium, Corynebacterium, Streptococci, Staphylococci, Proteus, Escherichia, Salmonella, Salmonella, Klebsiella, Pseudomonas, Pasteurella, Haemophilus, Bacillus, Brucella, Bordetella, Clostridium, Actinomyces, Leptospira, Mycoplasma, Borrelia, Bacteroides, etc.

Practical

Isolation and identification of various bacterial strains of veterinary importance.

Books Recommended

1. Collins, C.H., P. M. Lyne and J.M. Grange. 2000. Microbiological Methods. 8th Ed., Butter Worth Heinemann, Oxford.
2. Breeds, R.S., E. G.D. Murray and N.R. Smith. 1999. Bergey's Manual of Systemic Bacteriology. 11th Ed. William and Wilkins Company, Baltimore.

3. Parker, M.T. and L.H. Collin. 1998. Topley & Wilson's Principles of Bacteriology. Virology & Immunity. 9th Ed., Edward Arnold, London.
4. Virella, G. 1997. Microbiology and Infectious Diseases. 3rd Ed., Williams and Wilkins, New York.
5. Wilkins, New York.
6. Sharma, S.N. 1996. Text Book of Veterinary Microbiology. CBS Publications, Dehli.
7. Quinn, P.J, M.E. Carter, B.K. Markey and G.R. Carter. 1990. Clinical Veterinary Microbiology, Wolf, London.

ADVANCED VIROLOGY

Theory

Origin and nature of viruses, taxonomy and basis for classification, ultrastructure of virus.

Techniques of virus isolation, purification and identification. *In situ* virus detection,

Virus replication: Different models.

Viral genome analysis

Chemotherapy of viral infections: Virus inhibiting analogues, amino acid analogues, protein inhibitors, actinomycin-D, nucleic acid inhibitors.

Virus-host interaction: Cellular level, interference phenomenon, interferon, viral immunity.

Viral families of veterinary importance (family characteristics, epidemiology and pathogenicity).

Practical

Assay for bacteriophages. Infectivity assays of animal viruses, cultivation of viruses.

Plaque reduction test, virus neutralization and other serological tests.

Viral protein isolation and analysis.

Books Recommended

1. Rabbani, M. and M. A. Muneer. 2001. Techniques in Virology, 1st Ed., College of Veterinary Sciences, (University of Agriculture), Lahore.
2. Kahrs, R.F. 1998. Viral Diseases of Cattle. 2nd Ed. Iowa State University Press, Iowa.
3. Parker, M.T., & L.H. Collier. 1998. Topley & Wilson's Principles of Bacteriology, Virology & Immunity. 9th Ed., Edward Arnold. Pub. London.
4. Della-porta, A. J. 1995. Veterinary Viral Diseases – Their significance in South-East Asia and the Western Pacific. Academic Press, Sydney.
5. Fenner, F.J., E.P. Gibbs, F.A. Murphy, M.J. Studdert and D.O. White. 1993. Veterinary Virology. 2nd Ed., Academic Press, London.
6. Castro, A.E. and W.P. Henschele. 1992. Veterinary Diagnostic Virology. Mosby Year Book Inc., Missouri.

MYCOLOGY

Theory

Fungi, their general characteristics and classification, morphology, cultural characteristics, identification, reproduction, diagnosis of different pathogenic fungi, systematic study of diseases caused by the important genera of Phycomycetes groups (Mucor, Absidia, Rhizopus), Blastomycetes (Blastomyces Cryptococcus, Candida), Dermatophytes (Trichophyton, Microsporum, Epidermophyton), Fungi imperfecti (Sporotrichum, Histoplasma, Coccidioides) and others like Aspergillus, etc.

Immunity against fungi, prevention and treatment of mycotic infections. Mycotoxins and mycotoxicosis.

Practical

Isolation and identification of the yeasts and moulds.

Skin scrapings and identification of dermatophytes.

Single cell protein production and evaluation of various substrates.

Demonstration of various mycotoxins in feed, etc.

Books Recommended

1. Kurstak, E. 1999. Immunology of Fungal Diseases. Marcel Dekkar, Inc., New York.
2. Rippon, J.W. 1998. Medical Mycology- The Pathogenic Fungi and Pathogenic Actinomycetes. W.B. Sanders Co., Philadelphia.
3. Haley, L. D. and C.S. Callaway. 1998. Laboratory Methods in Mycology. Health Education and Welfare Publ. Co. CDC, Atlanta, Georgia.
4. Larone, D. H. 1997. Medically Important Fungi – A guide to Identification. Elsevier Sci. Publ. New York.
5. Evans, E.G.V. 1995. Essentials of Medical Mycology. Churchill Livingstone, New York.
6. Raper, K.B. and D.I. Fennell. 1995. The Genus Aspergillus. Williams and Wilkins Co. Baltimore.
7. Carter, G.R. 1993. Microbial Diseases: A Veterinarian Guide to Laboratory Diagnosis. Butter Worth Publ., New York.
8. Kaufman, L. 1991. Laboratory Diagnosis of Candidiasis, American Society for Microbiology, Washington DC.

MICROBIAL PHYSIOLOGY

Theory

Nutrient requirements of Microorganisms: Inorganic elements, sources of energy, sources of carbon, sources of nitrogen, growth factors, vitamins, amino acids, purines, pyrimidines and other organic compounds.

Physical environment: pH, temperature, osmotic pressure, radiation and gases.

Physiological and nutritional requirements during different phases of microbial growth.

Microbial fermentation: Glycolysis, Embden-Meyerhoff Parnas (EMP) Pathway, Warburg Dickens Pathway (Pentose Phosphate Pathway), The Entner-Doudoroff Pathway, Strokes-Cambell Pathway, yeast alcohol fermentations, bacterial alcohol fermentation, lactic acid fermentation, propionic acid fermentation and enterobacter fermentation.

Aerobic mechanisms (Respiration of bacteria): Tricarboxylic Acid (TCA) cycle or Krebs's Cycle, energetics of fermentation and respiration
Lipid metabolism including VFA synthesis by ruminal microbes.
Protein metabolism.

Practical

Bacterial growth curves.
Fermentation assays: Lactic acid, alcohol, etc.
Effects of various types of nutrients on the growth of bacteria.

Books Recommended

1. Dawes, I.W. and I. W. Sutherland. 1999. Microbial Physiology. 2nd Ed., Blackwell Scientific Publ, London.
2. Parker, M.T., and L.H. Collier. 1998. Topley and Wilson's Principles of Bacteriology, Virology & Immunity. 9th Ed., Edward Arnold. Pub., London.
3. Albert, C.M. and J.W. Foster. 1996. Microbial Physiology. 3rd Ed. John Wiley & Sons, New York.
4. Kumar, H.D. and L.C. Rai. 1986. Microbes & Microbial Processes. E.W.P., New Delhi.
5. Moat, A.G. and J.W. Foster. 1988. Microbial Physiology. A Wiley Interscience Publ. New York.

CELL CULTURE TECHNIQUES

Theory

Historical developments
Principles of cell culture: Over view of cell structure.
The cell: Division, types and tissues.

Behaviour of cell culture: Growth, differentiation and metabolism, primary, secondary and established lines, cell alteration or transformation, kinetics of cell growth, interaction among cell.

Cellular environment: Physical factors, nutritional factors, hormones and other growth factors.

Cell culture media: Plasma, serum, physiological fluids and tissue extracts.

Defined media: General consideration, balanced salt solutions, partially complete and complete synthetic media, special purpose media, media for poikilotherms, media for invertebrates, media for plants.

Design of a tissue culture Laboratory

Special techniques: Primary explant, (tissue culture, organ, embryo), disaggregation methods, cell lines,

Large scale culture methods: Cultivation of cells *in vitro*

Transplantation, preservation, storage, transportation of living tissues and cells.

Applications: General morphological techniques, quantitative techniques.

Tissue culture in research: Genetics, virology, host-parasite relationship, cancer, (tumor virus, transformation assays, cytotoxicity assays)

Standards cell lines mostly used for studying viruses of veterinary importance.

Biohazards

Practical

Laboratory layout for tissue culture work, special instruments for tissue culture, preparation of glassware for tissue culture, preparation of tissue culture media, harvesting of organs for tissue cultures, preparation of tissue cultures, quantitation of various viruses in tissue culture system and cytopathic effect of various viruses on tissue culture.

Books Recommended

1. Rabbani, M. and M. A. Muneer. 2001. Techniques in Virology, 1st Ed., College of Veterinary Sciences, (University of Agriculture), Lahore.

2. Anonymous, 1999. A Laboratory Manual for the Isolation and Identification of Avian Pathogens, 6th Ed. American Association of Avian Pathologists, Iowa State University Press, Ames., Iowa.
3. Freshney, R.I. 1997. Animal Cell Culture. I.R.L. Press, Oxford, London.
4. Paul, J. 1995. Cell and Tissue Culture. 8th Ed. Churchill Livingstone, London.
5. Versteeg, J. 1995. Color Atlas of Virology. Year Book Medical Publ. Ltd. London.
6. Carter, G. R. and A. W. Roberts. 1993. Outline of Veterinary Virology. 5th Ed. Lucas Brothers Publ., Los Angeles.
7. Castro, A.E. and W.P. Henschele. 1992. Veterinary Diagnostic Virology. Mosby Year Book Inc., St. Louis, Missouri.
8. Ministry of Agriculture, Fisheries and Food. 1984. Manual of Veterinary Investigation Laboratory Techniques, London.

ONCOGENIC VIRUSES

Theory

General consideration: DNA/RNA oncogenic viruses. Viral and cellular oncogenes. transplantation of tumour in animals by cell graft. Mechanisms of carcinogenesis. The search for oncogenic viruses in humans and working hypothesis on the aetiology of cancer. T and B cell Lymphomas. Virus induced tumours of veterinary importance.

Practical

Transformation of cells

Various methods for detection of transformed cells.

Detection of tumour antigens.

Induction of Shope rabbit papilloma.

Books Recommended

1. Jawetz, E. and W. Levinson. 2000. Medical Microbiology and Immunology, 5th Ed., Appleton & Lange, Stamford, New York.
2. Fraenkel-conrat, H., P.C. Kimball and J. A. Levy. 1998. Virology. Prentice Hall, Inc. New Jersey.
3. Fenner, F.J., E.P. Gibbs, F.A. Murphy, M.J. Studdert and D.O. White. 1993. Veterinary Virology. 2nd Ed., Academic Press, London.
4. Masseyeff, R. F., W.H. Albert and N. A. Staines. 1993. Methods of Immunological Analysis VCH Verlagsgesellschaft mbH, Weinheim, German.

MOLECULAR BIOLOGY OF BACTERIAL VIRUSES

Theory

Bacteriophages: Historical perspective, evolution, taxonomy, lytic cycle and lysogeny.

Biology and uses of DNA and RNA bacteriophages.

Bacteriophages used in the typing of bacteria.

Practical

Bacteriophage plaque assay, determination of one step growth curve, isolation and identification of different bacteriophages, bacteriophage typing of bacteria.

Books Recommended

1. Old R.W. and S.P. Primose. 1997. Principles of Gene Manipulation - An Introduction to Genetic Engineering. 3rd Ed., Blackwell Scientific Publications, London.
2. Freifelder, D. 1996. Molecular Biology. 3rd Ed., Jones & Bartlet Publishers, Inc., Boston.

3. Work, T.S. and E. Work. 1993. Laboratory techniques in Biochemistry and Molecular Biology. Vol.II, Elsevier Biomedical, Oxford.
4. Fenner, F.J., E.P. Gibbs, F.A. Murphy, M.J. Studdert and D.O. White. 1993. Veterinary Virology. 2nd Ed., Academic Press, London.
5. Fritsh, S.T. and T.E. Maniatis. 1991. Molecular Cloning. A Laboratory Manual. Coldspring Harbor Laboratory, New York.

ADVANCED ANAEROBIOLOGY

Theory

Introduction to anaerobiosis: Special physiological characteristics of anaerobes, anaerobic respiration; life without oxygen.

Methods of measuring respiratory activity: Barber's method, thumburg method. measurements of oxidation reduction intensity.

Methods of cultivation of anaerobes: Simple methods, (special media, infusion broth thioglycollate, etc.), method requiring special apparatus, cultivation of microaerophils and biochemical differentiation of anaerobes (special methods).

Epidemiology, Toxin production, diagnosis and immunoprophylaxis of clostridial diseases.

Anaerobes in rumen. Other anaerobes. Microaerophils.

Practical

Isolation and identification of anaerobes from rumen, etc.

Isolation and identification of clostridial species.

Identification and purification of toxin and preparation of toxoids.

Books Recommended

1. Buchanan, R. E. and Others (Eds). 1999. Bergey's Manual of Systematic Bacteriology. Williams and Wilkens, Baltimore.

2. Parker, M.T. & L.H. Collier. 1999. Topley & Wilson's Principles of Bacteriology, Virology & Immunity. 9th Ed., Edward Arnold. Pub., London.
3. Mackie, R.I., R.A. White and R.E. Ishaacson. 1997. Gastrointestinal Microbiology. Chapman and Hall Publ., New York.
4. Postgate, J. 1996. Microbes and Man. 3rd Ed., Cambridge University Press, New York.
5. Greenwood D., R.C.B. Slack and J.F. Pentherer. 1992. Microbiology. 14th Ed., ELBS, London.

ADVANCED SPIROCHAETOLOGY

Theory

History, General considerations and classification. Physiology epidemiology, serotypes, diagnosis and prophylaxis of Leptospira, Borrelia, Treponema, etc.

Practical

Staining and darkfield microscopy of the spirochaetes, isolation and identification of Leptospirae and Borrelia, serological tests for Spirochaetes.

Books Recommended

1. Jawetz, E. 2000. Medical Microbiology, 21st Ed. Prentice Hall Ltd. London.
2. Parker, M.T. & L.H. Collier. 1999. Topley & Wilson's Principles of Bacteriology, Virology & Immunity. 9th Ed., Edward Arnold. Pub., London.
3. Buchanan, R. E. and Others (Eds). 1999. Bergey's Manual of Systematic Bacteriology. Williams and Wilkens, Baltimore.
4. Calnek, B.W., H.J. Barnes, C.W. Beard, W.M. Reid and H.W. Yoder, 1998. Diseases of Poultry, 10th Ed. Wolf Pub. Co., Ltd., London.

5. Greenwood D., R.C.B. Slack and J.F. Pentherer. 1992. Microbiology. 14th Ed., ELBS, London.

IMMUNOLOGICAL TECHNIQUES

Practical

Bio-safety in an immunology laboratory. Techniques of antigen preparations: Particulate, soluble and subunit antigens, adjuvanting antigen and hapten, estimation of protein concentration, isolation and purification of bacterial and viral antigens.

Techniques in antibodies: Raising of polyclonal sera, purification of antibodies in serum samples and other secretions such as colostrums, preparation of dye and enzyme conjugated antisera, radio-labelling of soluble proteins, electrophoresis and electrofocussing, monoclonal antibodies.

Basic Cell Techniques: Isolation of lymphocytes from blood and lymphoid organs, separation of B and T cells, phagocytic cells, adherence of cells to sephadex, phagocytosis of iron powder, peritoneal and alveolar cell collection and characterization. Immunohistochemical techniques.

Books Recommended

1. Clausen, J. 1998. Immunological Techniques for Identification and Estimation of Macromolecules. 4th Ed., Elsevier Scientific Publishers, London.
2. Masseyeff, R. F., W.H. Albert and N. A. Staines. 1993. Methods of Immunological Analysis VCH Verlagsgesellschaft mbH, Weinheim, German.
3. Work, T.S. and E. Work. 1993. Laboratory Techniques in Biochemistry and Molecular Biology, Vol.II, Elsevier Biomedical, Oxford.
4. Hudson, L and F.C. Hay. 1991. Practical Immunology, 3rd Ed., Blackwell Scientific Publication, London.

TECHNIQUES IN MOLECULAR BIOLOGY

Theory

Safety guidelines in molecular biology, applications of molecular biology.

Protein profiling and amino acid sequencing.

Overview of physical and chemical structure of DNA, DNA replication, gene expression and DNA repair mechanisms in prokaryotes and eukaryotes.

Restriction enzymes: Isolation, purification, nomenclature, types and their use.

Cloning vectors, plasmids, bacteriophages, phagemids, cosmids; cloning strategies, genomic cloning into lambda phage and plasmid; DNA library construction, screening libraries, cloning into yeast.

PCR, LCR, and RFLP, etc. Chromosome walking and hopping, DNA fingerprinting, satellites and gene distancing.

Nucleic acid hybridization, labelling of probes, Northern and Southern blots, DNA sequencing.

Gene transfer into mice, gene transfer into farm animals, use of recombinant techniques in production of vaccines and biologics of veterinary importance.

Practical

Isolation of plasmid DNA, isolation of phage and lambda DNA, cloning genes into plasmids, transformation of E. coli with recombinant plasmid, rapid plasmid isolation from recombinants, western immunoblot, southern blot hybridization, methods for sequencing of DNA. PCR, LCR and RFLP

Books Recommended

1. Old. R. W. and S. R. Primrose. 1999. Principles of Gene Manipulation- An Introduction to Genetic Engineering, 5th Ed. Blackwell Scientific Publ., London.

2. Freifelder, D. 1998. Molecular Biology. 3rd Ed., Jones, & Bartlet Publishers, Inc., Boston.
3. Kumar, H. D. 1993. Recent Advances in Molecular Biology. Kalyani Publishers, New Delhi.
4. Sambrook, J., Fritsh and T. E. Maniatis. 1991. Molecular Cloning-A Laboratory Manual. Clodspring Harbor Laboratory, New York.

ADVANCED VETERINARY EPIDEMIOLOGY

Theory

Overview of Basic Principles: Epidemiologic concepts, sampling methods, measurement of disease determinants and frequencies.

Diseases in animal populations; Disease causation, surveys and analytical observational studies, design of field trials.

Sero-epidemiology: Expressing amounts of antibodies, serological estimation and comparison in populations, interpreting serological tests, flock profiling, serum banks. Designing a sero-epidemiological survey.

Molecular epidemiology: Overview, strain differentiation and bio markers, different methods.

Economics of disease: Livestock and poultry production as an economic process, economic analysis of animal diseases, assessing the cost of diseases, cost benefit analysis of disease control.

Health and productivity schemes: Development of standards of health and productivity.

Applied epidemiology: Rationale, surveillance and monitoring of disease, strategies and concepts of control and eradication of diseases, emergency preparedness.

Practical

Designing of questionnaire for disease surveillance, village search for disease, storage, analysis and interpretation of data, analysis and interpretation of passive surveillance data of veterinary hospitals. Hands on training of computer software for epidemiology.

Books Recommended

1. Blaha, T. 1999. Applied Veterinary Epidemiology. Elsevier Sci. Publ. London.
2. OIE. 1999. Manual of Standard for Diagnostic Tests and Vaccines. Office Intl. des. Epizooties, Paris.
3. Leech, F.B. and K.C. Sellers. 1997. Statistical Epidemiology in Veterinary Science. Charles Griffin and Co. Ltd., London.
4. Martin, S.W., A.H. Meek and P. Willeberg. 1997. Veterinary Epidemiology. Principles and Methods. Iowa State University Press, Ames, Iowa.
5. Friedman, G.D. 1994. Primer of Epidemiology. 4th Ed. McGraw-Hill Inc., Singapore.
6. Schulte, P.A. 1993. Molecular Epidemiology: Principles and Practices. Blackwell Publ. Co., London.
7. Knapp, R.G. and M.C. Miller. 1992. Clinical Epidemiology and Biostatistic, William and Wilkinsons, Baltimore.
8. Thrushfield, M. 1992. Veterinary Epidemiology. Butterworth and Co., Ltd., London.

VACCINES AND VACCINOLOGY

Theory

Overview of natural resistance to disease, antibodies, antigens, immune cells, cell-mediated immunity.

Principles of vaccine production; Production of killed, live attenuated, subunit and recombinant vaccines of veterinary importance, immune reactions associated with different vaccines. Master seed and working seed. Fermentation technology in vaccine production (batch and continuous system), Handling and storage of vaccines, adjuvants and immuno-potentiators.

Vaccination: methods, schedules for different production systems, vaccination for mucosal immunity, immune responses on population basis, evaluation of vaccines.

Vaccinal failure, factors associated with host, vaccine and vaccination, return to virulence.

Products for passive immunity; hyperimmune sera, colostrum and colostrum immunoglobulins, non-specific protein therapy and immunity. Quality control in vaccine production.

Vaccine certification: Requirements and produces.

Practical

Layout of a biological production facility, preparation of live attenuated, killed vaccines and toxoid, fermentation: Batch and continuous flow systems, determination of required dose (ED50) of vaccine. Evaluation of vaccines (sterility, safety and potency), Study visit to a vaccine production facility.

Books Recommended

1. OIE. 1999. Manual of Standards for Diagnostic Tests and Vaccines, 2nd Ed., Office International des Epizooties, Paris.
2. Isaacson, R.E. 1999. Recombinant DNA Vaccines: Rational and Strategy. Marcel Dekker, Inc., New York.
3. Peters, A. R. 1998. Vaccines for Veterinary Applications. Butter Worth, Heinemann, Oxford.
4. Pandey, R., S. Hogland and G. Prasad. 1998. Veterinary Vaccines. Vol-4. Springer Verlag Inc. New York.
5. British Pharmacopoeia (Veterinary). 1993. Veterinary Vaccines, London.

MICROBIAL GENETICS

Theory

Bacterial nucleoid and DNA packing in prokaryotes, bacterial DNA replication, transcription; RNA processing, types and functions of RNAs, modifying enzymes, translation in E. coli, degradation of abnormal proteins,

antibiotics that affect nucleic acids and protein synthesis, polarity of the genetic material of viruses, reverse transcription mechanism.

Transfer of genetic information; mechanism of transformation and transfection in bacteria, conjugation and F and R plasmids, conjugal transfer process, barriers to conjugation, Hfr formation, F-prime formation, cis-trans complementation test, lethal zygosis, conjugation and pheromones in streptococci, transduction, lysogenic conversion, recombination and genetics of spontaneous nature of mutational events.

DNA repair systems, photoreactivation, excision repair, mismatch repair, DNA glycosylases, methylating and ethylating agents, post-replication daughter gap repair, SOS- inducible repair, Weigle reactivation and mutagenesis.

Regulation of prokaryotic gene expression; transcriptional control, the lac operon, catabolic control, the gal operon, the ara operon, the trp operon, the arginine control, membrane mediated regulation, recombination regulation of gene expression, translation repression, global control. Genetic control of SOS: heat shock response, aerobic, anaerobic stimulons. Regulation and gene expression in lambda, M13 and Mu phages, restriction and modification system of prokaryotic DNA.

Books Recommended

1. Old, R. W. and S. B. Primrose. 1998. Principles of Gene Manipulation - An Introduction to Genetic Engineering, 4th Ed. Blackwell Scientific Publ. London.
2. Freifelder, D. 1997. Microbial Genetics, Boston, Jones and Bartlett Publishers, Inc., New York.
3. Kumar, H. D. 1993. Recent Advances in Molecular Biology. Kalyani Publishers, New Delhi.
4. Sambrook, J., Fritsh and T.E., Maniatis, 1991. Molecular Cloning - A Laboratory Manual. Coldspring Harbor Laboratory, New York.

AVIAN IMMUNOLOGY

Theory

Avian Immune System: Cells and tissues with special emphasis on bursa, thymus, spleen, Peyer's patches, Harderian gland.

Humoral and cell-mediated immune response: induction and effector mechanisms. Ontogeny of avian immune system. Maternally derived antibodies.

Poultry vaccines and vaccinations: types and methods, troubleshooting, vaccine failure.

Flock profiling and interpretations; Serum and egg yolk antibodies, immunomodulation.

Practical

Flock profiles: (at least 10 different flock profiles will be shown and discussed)

Methods of vaccination.

Determination of yolk and serum antibodies

Effect of removal of lymphoid organs.

Devising, implementing and monitoring of a vaccination schedule for chickens.

Books Recommended

1. OIE. 2000. Manual of Standard for Diagnostic Tests and Vaccines. Office Intl. Des Epizooties, Paris.
2. Tizzard, I. 1999, Veterinary Immunology- An Introduction, 7th Ed., W.B. Saunders Co., London.
3. Calnek, B.W., H.J. Barnes, C.W. Beard, W.M. Reid and H.W. Yoder, 1998. Diseases of Poultry, 10th Ed. Wolf Pub. Co., Ltd., London.
4. Pandey, R., S. Hogland and G. Prasad. 1998. Veterinary Vaccines. Vol-4. Springer Verlag Inc. New York.

5. Peters, A. R. 1998. Vaccines for Veterinary Applications. Butter Worth, Heinemann, Oxford.
6. Rose, M. E., L. N. Payne and B. M. Freeman. 1998. Avian Immunology. British Poultry Sci. Ltd., Edinburgh.
7. Gershwin, L.J., S. Krakowka and R.G. Olsen. 1994. Veterinary Immunology and Immunopathology, 2nd Edition. Mosby, New York.
8. Anonymous 1993. Veterinary Vaccines, British Pharmacopoeia (Veterinary). London.
9. Hudson, L. and C.H. Frank, 1992. Practical Immunology, 3rd Ed., Blackwell Scientific Publications, London.

ADVANCED READINGS IN IMMUNOLOGY

Review and critique of the paper published in recent journals on selected topics. The students will present the detail of techniques used, results obtained and his/her own critique on the validity, use of results and conclusions with his/her recommendations.

ADVANCED READINGS IN BACTERIOLOGY

Review and critique of the paper published in recent journals on selected topics. The students will present the detail of techniques used, results obtained and his/her own critique on the validity, use of results and conclusions with his/her recommendations.

ADVANCED READINGS IN VIROLOGY

Review and critique of the paper published in recent journals on selected topics. The students will present the detail of techniques used, results obtained and his/her own critique on the validity, use of results and conclusions with his/her recommendations.

ADVANCED READINGS IN MYCOLOGY

Review and critique of the paper published in recent journals on selected topics. The students will present the detail of techniques used,

results obtained and his/her own critique on the validity, use of results and conclusions with his/her recommendations.

MINOR, DEFICIENCY AND REFRESHER COURSES

MICROBIOLOGICAL TECHNIQUES

(Note: Minor course for students other than microbiology department)

Biosafety in microbiology Laboratory, sterilization methods, cultivation of bacteria, culture media, growth of bacteria and their characteristics, counting of bacteria, bacteriological examination of sputum, pus, faeces, urine, tissue, blood, food, water, milk, air, etc., biochemical tests for characterization of bacteria, evaluation of antimicrobial agents and disinfectants. isolation and identification of fungi, isolation and identification of virus, serological tests.

Books Recommended

1. Collins, C.H., P. M. Lyne and J.M. Grange. 2000. Microbiological Methods. 8th Ed., Butter Worth Heinemann, Oxford.
2. Gardner, J.F. and M.M. Pul. 1998. Introduction to Sterilization, Disinfection and Infection Control. 2nd Ed. Churchill, Livingstone, London.
3. Wedding, M.E. and S.A. Toenyes. 1994. Medical Laboratory Procedures, Jaypee Brothers, New Delhi.
4. Hudson, L. and F.C. Hay. 1991. Practical Immunology, 3rd Ed. Blackwell Scientific Pub., London.

POSTGRADUATE REFRESHER COURSE IN BACTERIOLOGY
VIROLOGY, IMMUNOLOGY & EPIZOOTIOLOGY

Theory

1. Bacteriology

Bacterial morphology, growth curves, antiseptics and disinfectant. Bacteriostatic substances and their use. Antibiotics and their use.

Identification of organisms and discussion of important disease condition produced by Staphylococci, Streptococci, Clostridium, Bacillus, Escherichia, Salmonella. Proteus, Shigella, Vibrio, Corynebacterium, Listeria, Erysipelothrix, Pasteurella, Brucella, Mycobacterium, Actinomyces, Actinobacillus, Leptospira and Mycoplasma.

Practical

Use and care of microscope. Staining techniques, Gram's method. Ziehl-Nielsen's methods, Romanowski stain, preparation of glass ware, sterilization, collection and despatch of material for bacteriological examination. Preparation and use of culture media. Isolation and study of pure cultures.

2. Virology

General Virology: Introduction. Nature and chemical composition, classification, multiplication, general characteristic of virus infections. Viral vaccines and viral immunity including interference phenomenon.

Special Virology: Discussions on important viral diseases with particular emphasis on Rinderpest, Foot and Mouth disease, Rabies. African Horse Sickness, Blue Tongue, Newcastle disease, Fowl Plaque. Avian Leukosis complex, Pox disease, Encephalitis, Contagious pustular dermatitis, etc.

Practical

Collection, despatch and preparation of specimens for virus isolation, filtration, centrifugation, virus assay in chicken embryos,

demonstration of tissue culture techniques, haemagglutination inhibition, virus neutralization, LD₅₀ determination. ELISA, Electrophoresis.

3. Veterinary Mycology

Introduction, classification, general characteristics of fungal infections, discussion on dermatophytes, aspergillosis, phycomycosis, coccidiomycosis, mpsiromycosis, histoplasmosis, sporotrichosis, rhinosporodiosis, blastomycosis, cryptococcosis, candidiosis and toxicoses.

Practical

Collection, isolation and identification of fungi; examination of fungal slides.

4. Immunology and Epizootiology

Infections and resistance, defence mechanisms of body, Immunity and immunization, general properties of antigens and antibodies, antigen and antibody reactions, agglutination, precipitation, complement fixation reactions. Hypersensitivity, anaphylaxis and allergy. Preparation and use of veterinary biological vaccines, sera and diagnostic agents.

Herd infections, factors affecting host, parasite and environmental conditions, prevention and control of epizootics.

Practical

Serological tests-agglutination, precipitation, complement fixation reaction, tuberculin and mallein tests.

Books Recommended

1. Roitt, I. M. 2000. Essential Immunology, 9th Ed., ELBS/Blackwell Scientific Publ., London.

2. Parker. M. T. and L. H. Collin.1998. Topley & Wilson's Principles of Bacteriology. Virology & Immunity. 9th Ed., Edward Arnold. A division of Hodder & Stroughton, London.
3. Hudson, L. and C.H. Frank, 1992. Practical Immunology, 3rd Ed., Blackwell Scientific Publ, London.
4. Tortora, G. J., B. R. Funke and C. L. Case.1992. Microbiology - An Introduction. The Benjeman/Cummings publishing company, Inc, California.

RECOMMENDATIONS

1. Teachers should be sent for short training inland/abroad for updating their knowledge especially on the latest techniques in the area of their specialization. Expertise of different institutes/universities may be pooled to offer an inland training course on emerging themes.
2. Teaching/Technical/Laboratories staff shortage may be rectified.
3. Well equipping of teaching labs in terms of equipment, operation of the equipment and provision of adequate financial support is recommended.
4. Appointments and adequate training of laboratory technicians on the various equipments in the laboratory is recommended. Lab Technicians should have their own service cadre.
5. The courses recommended in the microbiology for undergraduate teaching to the DVM students are at the minimum required level which should be adopted at the national level.
6. Adequate library facilities may be provided to teachers/students especially for the literature search and availability of recommended textbooks and other teaching aids.
7. Adequate space for teaching in lecture and practical may be provided.
8. University teachers actively involved in research in addition to teaching may be given research allowance.
9. The theory class should not exceed 50 and in practical 25 students. In case university admits more than these numbers, separate sections of multiple of 50 be created and the teachers may be provided additional remuneration for taking evening classes.
10. There are chances of duplication in courses of different departments both at undergraduate and postgraduate level. UGC should make efforts to eliminate/minimize these duplications.
11. Adhocism in faculty appoints should be discouraged. Core faculty in each department according to workload may be provided.
12. Career structure for the university teachers be planned. This should include performance and time scale basis for the promotion of the teachers.