

## VETERINARY MICROBIOLOGY

CODE	COURSE TITLE	CREDITS
VMC 601	BACTERIOLOGY - I	3+1
VMC 602	BACTERIOLOGY - II	3+1
VMC 603	VETERINARY MYCOLOGY	1+1
VMC 604	GENERAL VIROLOGY	2+1
VMC 605	SYSTEMATIC ANIMAL VIROLOGY	3+1
VMC 606	PRINCIPLES OF IMMUNOLOGY	2+1
VMC 607	VACCINOLOGY	2+0
VMC 608	DIAGNOSTICS OF INFECTIOUS DISEASES	1+2
VMC 609	TECHNIQUES IN MICROBIOLOGY AND IMMUNOLOGY	0+3
VMC 691	MASTER'S SEMINAR	1+0
VMC 699	MASTER'S RESEARCH	20
VMC 701	ADVANCES IN BACTERIOLOGY	2+1
VMC 702	ADVANCES IN MYCOLOGY	2+1
VMC 703	BACTERIAL GENETICS	2+1
VMC 704	MICROBIAL TOXINS	2+1
VMC 705	MOLECULAR DETERMINANTS OF BACTERIAL PATHOGENESIS	2+1
VMC 706	ADVANCES IN VIROLOGY	2+1
VMC 707	MOLECULAR AND GENETIC ASPECTS OF VIRAL PATHOGENESIS	2+1
VMC 708	STRUCTURE FUNCTION RELATIONSHIP OF DNA AND RNA VIRUSES	3+0
VMC 709	ONCOGENIC VIRUSES	2+0
VMC 710	SLOW VIRAL INFECTIONS AND PRIONS	2+0
VMC 711	MOLECULAR IMMUNOLOGY	2+1
VMC 712	ADVANCES IN CELLULAR IMMUNOLOGY	2+1
VMC 713	CYTOKINES AND IMMUNOMODULATORS	2+0
VMC 714	ADVANCES IN VACCINOLOGY	2+0
VMC 715	ADVANCES IN IMMUNODIAGNOSTICS	1+1
VMC 716	MODERN IMMUNOTECHNOLOGY	1+2
VMC 717	CURRENT TOPICS IN INFECTION AND IMMUNITY	3+0
VMC 718	VETERINARY MICROBIAL BIOTECHNOLOGY	2+1
VMC 790	SPECIAL PROBLEM	0+2
VMC 791	DOCTORAL SEMINAR I	1+0
VMC 792	DOCTORAL SEMINAR II	1+0
VMC 799	DOCTORAL RESEARCH	45

### VMC 601: BACTERIOLOGY - I

**3+1**

#### Objective

To impart knowledge on general microbiology and important aerobic bacteria.

#### Theory

#### UNIT I

Introduction to historical development of cellular organization, genetic & chemical characteristics of eukaryotic and prokaryotic cells. Classification, nomenclature and identification; genetic characterization and numerical taxonomy. Bacterial cell structure, physiology and antigenic structure.

#### UNIT II

Determinants of pathogenicity and its molecular basis. Bacteriophages: temperate and virulent phages; lysogeny and lysogenic conversion. Bacterial genetics: bacterial variation, genetic transfer mechanisms (transformation, transduction and conjugation); plasmids, transposons and drug resistance; recombinant DNA technology.

### **UNIT III**

Systemic study of following bacteria: Gram negative- aerobic rods and cocci, family *Pseudomonadaceae*, *Legionellaceae*, *Neisseriaceae*, and genus *Brucella*. Facultative anaerobic Gram negative rods, family- *Vibrionaceae*, *Pasteurellaceae*, *Enterobacteriaceae* and other genera.

#### **Practical**

Morphological characterization, cell fractionation, enrichment & isolation technology, various methods used in growth measurement and bacterial preservation, gene transfer experiment. Detailed characterization (biochemical, serological, pathogenicity) of bacteria.

#### **Suggested Readings**

Glen Sonder J & Karen W Post 2005. *Veterinary Microbiology: Bacterial & Fungal Agents of Animal Diseases*. Cold Spring Harbor Lab. Press.

Prescott LM, Harley JP & Klen DA. 2005. *Microbiology*. Wm. C. Brown Publ.

Tortora GJ, Funke BR & Case CL. 2004. *Microbiology: An Introduction*. Benjamin/Cummins Publ

### **VMC 602: BACTERIOLOGY – II**

**3+1**

#### **Objective**

To learn about spore forming bacteria and some important aerobes and anaerobes.

#### **Theory**

### **UNIT I**

Systematic study of following pathogenic bacteria: Gram positive cocci, family *Micrococaceae*, endospore forming Gram positive rods and cocci, family *Bacillaceae* genus *Bacillus*, *Sporolactobacillus* and *Clostridium*. Spirochetes. Family *Spirochetaceae* and other families like *Spirillaceae*, coryneform bacteria, *Dermatophilaceae*, *Streptomyetaceae*.

*Mycobacteria* and *Nocardia*, family *Actinomycetaceae*. Atypical prokaryotes such as *Chlamydia*, *Rickettsiae*, *Mycoplasma*, *Acholeplasma*, *Spiroplasma*, *Anaeroplasma* and *Thermoplasma*.

### **UNIT III**

Regular non-sporing Gram positive rods such as *Listeria* and *Erysipelas*. Anaerobic Gram negative straight, curved and helical rods, family *Bacteroidaceae* and genus *Bacteroides* and *Fusobacterium*.

#### **Practical**

Detailed and comparative study of morphology, biochemical reactions, physiology, serology and pathogenicity of various bacteria studied in theory, isolation of bacteria from field materials leading to their characterization and identification.

#### **Suggested Readings**

Glen Sonder J & Karen W Post 2005. *Veterinary Microbiology: Bacterial and Fungal Agents of Animal Diseases*. Cold Spring Harbor Lab. Press.

Prescott LM, Harley JP & Klen DA. 2005. *Microbiology*. Wm. C. Brown Publ.

Tortora GJ, Funke BR & Case CL. 2004. *Microbiology: An Introduction*. Benjamin/Cummins Publ.

### **VMC 603: VETERINARY MYCOLOGY**

**1+1**

**Objective :** To learn general and pathogenic mycology.

#### **Theory**

### **UNIT I**

Morphology, physiology, reproduction, cultural characters, classification of fungi, immunology of pathogenic fungi.

### **UNIT II**

Systematic study of animal mycoses such as aspergillosis, candidiasis, cryptococcosis, epizootic lymphangitis, mycetomas, sporotrichosis, histoplasmosis, blastomycosis, coccidioidomycosis, haplomycosis, rhinosporidiosis, zygomycosis, mycotic abortion, mycotic mastitis, mycotic dermatitis, dermatophytoses, mycotoxicosis etc.

#### **Practical**

Collection and processing of clinical material for isolation of fungi. Study of gross and microscopic characters of pathogenic fungi.

#### **Suggested Readings**

Glen Sonder J & Karen W Post 2005. *Veterinary Microbiology: Bacterial and Fungal Agents of Animal Diseases*. Cold Spring Harbor Lab. Press.

### **VMC 604: GENERAL VIROLOGY**

**2+1**

#### **Objective**

To study general aspects of viral structure, classification, replication, interactions and immunity to viruses.

#### **Theory**

### **UNIT I**

History of virology; origin and nature of viruses; biochemical and morphological structure of viruses; nomenclature and classification of viruses.

## **UNIT II**

Replication of DNA and RNA viruses, viral genetics and evolution.

## **UNIT III**

Genetic and non-genetic interactions between viruses, virus-cell interactions, viral pathogenesis, viral persistence, oncogenic viruses, epidemiology of viral infections.

## **UNIT IV**

Immune response to viruses, viral vaccines, viral chemotherapy.

### **Practical**

Orientation to a virology laboratory, preparation of equipment for sterilization, collection, preservation, transportation of samples and their processing, isolation and cultivation of viruses in animals/ birds, embryonated chicken eggs; media and reagents for cell culture, trypsinization and maintenance of monolayer cell cultures, isolation of virus in cell cultures, titration of viruses by 50% end-point cytopathogenicity, and haemagglutination; detection of viral antibodies by serum neutralisation test, agar gel precipitation test, haemagglutination inhibition and ELISA.

### **Suggested Readings**

Acheson NH. 2006. *Fundamentals of Molecular Virology*. Wiley.

Carter J & Saunders V. 2007. *Virology: Principles and Applications*. 1<sup>st</sup> Ed. Wiley.

Knipe DM, Howley PM, Griffin DE. 2006. *Fields Virology*. 5<sup>th</sup> Ed. Vols. I,II. Lippincott, Williams & Wilkins. Mahy BWJ & Kangaroo HO. 1996. *Virology Methods Manual*. Academic Press.

Murphy FA, Gibbs, EPJ, Holzmek MK & Studdert MJ. 1999. *Veterinary Virology*. 3<sup>rd</sup> Ed. Academic Press.

## **VMC 605: SYSTEMATIC ANIMAL VIROLOGY**

**3+1**

### **Objectives**

To study viral properties, epidemiology, pathogenesis, diagnosis and control of diseases caused by animal viruses.

### **Theory**

#### **UNIT I**

Studies on animal viruses belonging to various families, and prion agents given below with reference to antigens, cultivation, pathogenesis, epidemiology, disease status in India, diagnosis, immunity and control. Capripoxvirus, avipoxvirus, cowpoxvirus; bovine herpes viruses, equine herpes viruses, infectious laryngotracheitis virus, Marek's disease virus, pseudorabies virus, malignant catarrh fever virus; infectious canine hepatitis virus, egg drop syndrome virus, inclusion body hepatitis-hydropericardium virus, papillomatosis, canine parvoviruses, feline panleucopenia virus.

#### **UNIT II**

New castle disease virus, canine distemper virus, rinderpest virus, PPR virus; infectious bursal disease virus; rotavirus, blue tongue virus, African horse sickness virus; rabies virus, ephemeral fever virus, borna virus.

#### **UNIT III**

Infectious bronchitis virus, transmissible gastroenteritis virus; equine arteritis virus, equine encephalomyelitis viruses; swine fever virus, BVDV-mucosal disease virus; foot and mouth disease virus, duck hepatitis virus; visna/maedi virus, equine infectious anemia virus, avian leucosis complex virus, bovine leukemia virus, chicken anemia virus; prions: scrapie, bovine spongiform encephalopathy.

### **Practical**

Isolation of viruses in embryonated eggs and cell cultures; cytopathogenicity of representative animal viruses viz., cell death, syncytia formation, inclusion body etc.; diagnosis of animal viruses employing various serological tests, viz., haemagglutination and haemagglutination inhibition for Newcastle disease virus, agar gel diffusion and virus neutralization test for infectious bursal disease viruses; diagnosis of IBD virus and rotavirus by latex agglutination test, serotyping of FMD virus by ELISA, electrophoretotyping of rotavirus, PCR for diagnosis of viral infections.

### **Suggested Readings**

Acheson NH. 2006. *Fundamentals of Molecular Virology*. Wiley.

Carter J & Saunders V. 2007. *Virology: Principles and Applications*. 1<sup>st</sup> Ed. Wiley.

Knipe DM, Howley PM, Griffin DE. 2006. *Fields Virology*. 5<sup>th</sup> Ed. Vols. I, II. Lippincott, Williams & Wilkins. Mahy, BWJ & Kangaroo HO. 1996. *Virology Methods Manual*. Academic Press.

Murphy FA, Gibbs, EPJ, Holzmek MK & Studdert MJ. 1999. *Veterinary Virology*. 3<sup>rd</sup> Ed. Academic Press.

## **VMC 606: PRINCIPLES OF IMMUNOLOGY**

**2+1**

### **Objective**

To impart knowledge about fundamental principles of immunology and its applications in the field of infectious diseases.

### **Theory**

#### **UNIT I**

History of immunology, immunity types, cardinal features, phylogeny. Vertebrate immune system: lymphoid organs and tissues; development of B and T lymphocyte repertoires and other leukocytes, differentiation markers and other distinguishing characters of leukocytes; lymphoid cells trafficking.

## **UNIT II**

Antigens: fundamental features, types, factors affecting immuno-genicity, adjuvants. Antibodies: structure, functions and classification; theories of antibody production; immunoglobulin genes and genetic basis of antibody diversity. Complement system: activation pathways and biological activities.

## **UNIT III**

Major histocompatibility complex: structure, functions and gene organization. T lymphocyte subsets. Antigen-specific T cell receptors: structure, gene organization and genetic basis of diversity. Immune response development: phases of humoral and cell-mediated immune response development, cellular interactions, properties and classification of various cytokines, immunoregulation.

## **UNIT IV**

Immunity against veterinary infectious agents, immunological surveillance and cancer immunity, immunological tolerance, its breakdown and autoimmunity, immuno-deficiencies: types and examples, hypersensitivity: classification, mechanisms of induction and examples.

### **Practical**

Preparation of antigens for laboratory animals immunization; production, collection and preservation of antisera; quantitation of immunoglobulins in antisera by zinc sulphate turbidity and single radial immunodiffusion; examination of lymphoid organs of animals; tests for *in vivo* and *in vitro* phagocytosis; separation and counting of peripheral blood lymphocytes; separation and concentration of immunoglobulin by ammonium sulphate precipitation and dialysis; demonstration of antigen- antibody interactions in serological tests such as agar gel precipitation, immunoelectrophoresis, bacterial agglutination, direct and passive hemagglutination, latex agglutination, complement fixation, enzyme-linked immunosorbent assay, immunoblotting.

### **Suggested Readings**

Kindt TJ, Goldsby RA & Osborne BA. 2007. *Kuby Immunology*. 6<sup>th</sup> Ed. WH Freeman.

Male D, Brostoff J, Roth DB & Roitts I. 2007. *Immunology*. 7<sup>th</sup> Ed. Mosby-Elsevier.

Tizard IR. 2004. *Veterinary Immunology: An Introduction*. 7<sup>th</sup> Ed. Saunders/Elsevier.

## **VMC 607: VACCINOLOGY**

**2+0**

### **Objective**

To understand science and practice of vaccines for prevention of bacterial and viral diseases.

### **Theory**

#### **UNIT I**

History of veterinary vaccinology. Vaccines: classification, comparison of major types. Components of various types of vaccines: immunogens, adjuvants, stabilizers, preservatives, vehicles. Vaccine qualities: definitions and methods of testing. Vaccine development: cost-effectiveness of preventive immunization programmes, stages of development, clinical trials and regulatory requirements.

#### **UNIT II**

Traditional vaccines: inactivated, attenuated and toxoid vaccines. Methods of construction of traditional vaccines: microbial cultures, embryonated eggs, cell culture. Seed-lots of vaccine organisms. Methods of inactivation and attenuation of pathogens.

#### **UNIT III**

Modern vaccines: nucleic acids, vectored vaccines, recombinant expressed immunogens, synthetic peptides, marker vaccines, etc. Combination/multivalent vaccines. Novel immunomodulators and delivery systems. Modern methods of vaccine construction: methods based on synthetic chemistry and rDNA technology.

#### **UNIT IV**

Vaccine formulation: pharmacopeal requirements. Vaccine stability and preservation: cold chain. Immunization schedules of veterinary vaccines, logistic problems and vaccination failure. Strategies of disease control and eradication by vaccination.

### **Suggested Readings**

Dodds WJ & Schulz R. (Eds). 1999. *Veterinary Vaccines and Diagnostics*.

Vol. 41 (*Advances in Veterinary Medicine*) 1<sup>st</sup> Ed. Academic Press. Levine MM, Kaper JB, Rappuoli R, Liu MA & Good MF. 2004. *New*

*Generation Vaccines*. 3<sup>rd</sup> Ed. Marcel-Dekker. Pastoret PP, Blancou J, Vannier C & Verschueren C. 1997. *Veterinary Vaccinology*. Elsevier.

## **VMC 608: DIAGNOSTICS OF INFECTIOUS DISEASES**

**1+2**

### **Objective**

To provide training in essential immunological and molecular diagnostic techniques.

### **Theory**

#### **UNIT I**

Diagnosis of infectious diseases: an overview. Principles of serodiagnostic: agglutination-reaction based tests, precipitation-reaction based tests, complement fixation test and enzyme immunoassays.

#### **UNIT II**

Principles of molecular diagnostic tests: PCR, RT-PCR, Southern blotting, northern blotting, western blotting, dot-blot. DNA diagnostics versus serodiagnostics. Development and validation of diagnostic tests.

### **Practical**

Serodiagnostic tests for infectious diseases: bacterial slide and microtitre plate agglutination, agar gel immunodiffusion test, passive hemagglutination, hemagglutination inhibition and latex agglutination tests, complement fixation test, enzyme linked immunosorbent immunoassays, dot-ELISA, fluorescent antibody technique, immuno-electron microscopy, virus neutralization test, etc.

Molecular diagnostic techniques: protein profiling of infectious agents by SDS-polyacrylamide gel electrophoresis, antigen profiling of infectious agents by immunoblotting, nucleic acids isolation from infectious agents, detection of infectious agent nucleic acids by various formats of polymerase chain reaction and reverse transcription-PCR, dot-blot technique, etc.

### **Suggested Readings**

Detrick B & Hamilton RG. (Eds). 2006. *Manual of Molecular and Clinical Laboratory Immunology*. 7<sup>th</sup> Ed. American Society for Microbiology.

Rose NR, Friedman H & Fahey JL. (Eds). 1986. *Manual of Clinical Laboratory Immunology*. American Society for Microbiology.

Weir DM. 1986. *Handbook of Experimental Immunology*. Vol. IV. Blackwell.

### **VMC 609: TECHNIQUES IN MICROBIOLOGY AND IMMUNOLOGY**

**0+3**

#### **Objective**

To learn various important techniques of bacteriology, virology and immunology.

#### **Practical**

Preparation of different media used in bacteriology and mycology; isolation and identification of bacteria and fungi; antibiotic sensitivity of microorganisms from clinical specimens. Plasmid profiling, pathogenicity test in cell culture or laboratory animals, maintenance and preservation of bacteria and fungi.

Cryopreservation and reconstitution of preserved cell lines; Concentration and purification of animal viruses by chemical agents, differential centrifugation, density gradient centrifugation, and ultra filtration, etc. Storage of animal viruses by freeze drying and ultra freezing. Biophysical and biochemical characterization of animal viruses; Molecular characterization of viral protein and nucleic acid. Immunoglobulin purification by salt precipitation and chromatographic techniques, anti-species antibody production, enzyme-linked immunosorbent assays for antigen and antibody detection, neutrophils and peritoneal macrophage isolation and demonstration of phagocytic activity, lymphocyte separation, lymphocyte proliferation assay, tuberculin-type delayed type hypersensitivity reaction.

#### **Suggested Readings**

Coligan JE, Kruisbeek AM, Margulies DH, Shevach EM & Strober W.

2003. *Current Protocols in Immunology*. 3<sup>rd</sup> Ed. John Wiley & Sons. Detrick B & Hamilton RG. (Eds). 2006. *Manual of Molecular and Clinical Laboratory Immunology*. 7<sup>th</sup> Ed. American Society for Microbiology.

Hay FC & Westwood OMR. 2002. *Practical Immunology*. 4<sup>th</sup> Ed. Blackwell.

Mahy BWJ & Kangaro HO. 1996. *Virology Methods Manual*. Academic Press.

Quinn PJ, Carter ME, Markey B & Carter GR. 1994. *Clinical Veterinary Microbiology*. Wolfe Publ.

### **VMC 701: ADVANCES IN BACTERIOLOGY**

**2+1**

#### **Objective**

To learn about the latest development in the field of bacteriology

#### **Theory**

##### **UNIT I**

Advanced studies on cytology, biochemical activities, antigenic structure and molecular biology of bacteria

##### **UNIT II**

Advanced studies on pathogenicity, immunology and serology of bacteria.

#### **Practical**

Biochemical, physiological and pathogenesis studies of various bacterial diseases.

#### **Suggested Readings**

Selected articles from journals

### **VMC 702: ADVANCES IN MYCOLOGY**

**2+1**

#### **Objective**

To learn about the latest development in the field of mycology.

#### **Theory**

##### **UNIT I**

Advanced studies on taxonomic genetics, physiology and antigenic characterization of pathogenic fungi.

##### **UNIT II**

Advanced studies on molecular approaches for identification of fungi and immunology and serology of mycoses.

#### **Practical**

Biochemical, physiological and pathogenesis studies of various fungal diseases.

#### **Suggested Readings**

Selected articles from journals

### **VMC 703: BACTERIAL GENETICS**

**2+1**

#### **Objective**

To learn the basic aspects of bacterial genetics.

#### **Theory**

##### **UNIT I**

Procaryotic and Eucaryotic genome. Replication of eucaryotic and procaryotic DNA. Structure, classification and replication of plasmids. Molecular basis of mutations.

##### **UNIT II**

Biochemical genetic and gene mapping by recombination, fine gene structure analysis. Gene transfer in bacteria through transduction, transformation and conjugation and gene mapping by these processes.

##### **UNIT III**

Transposable elements. Gene cloning and gene sequencing. Regulation of gene expression.

**Practical**

Mutagenesis of microorganisms by different methods. Production, isolation and characterization of mutants. Determination of mutation rate. Isolation, characterization and curing of plasmids. Transfer of plasmid by conjugation, electroporation. Tetrad and random spore analysis.

**Suggested Readings**

Selected articles from journals.

**VMC 704: MICROBIAL TOXINS****2+1****Objective**

To learn about the bacterial and fungal toxins.

**Theory****UNIT I**

The role of microbial toxins in the pathogenesis of diseases; biochemical and biological characteristics of toxins produced by various bacteria. Toxin producing Gram positive and negative bacteria. Properties and clinical conditions produced by different bacterial toxins.

**UNIT II**

Production, characterization, and study of pathogenicity of various fungal toxins.

**Practical**

Isolation of toxigenic strains of bacteria from suspected material, production of toxins in suitable media, purification and characterization of toxins; biological characterization in animal and in tissue culture; immunobiological studies of toxins.

**Suggested Readings**

Selected articles from journals.

**VMC 705: MOLECULAR DETERMINANTS OF BACTERIAL PATHOGENESIS****2+1****Objective**

To learn the molecular mechanisms of bacterial pathogenesis.

**Theory****UNIT I**

Molecular structure, production and mode of action of bacterial adhesins, invasins, impedins, aggressins, modulins, capsule, flagella, enzymes, components of cell wall and siderophores.

**UNIT II**

The production, structure and molecular mechanism of actions of various exotoxins and endotoxins, siderophores and cytotoxins, and plasmids in causation of disease.

**Practical**

To study the production and effects of exotoxins and endotoxins, LPS and various enzymes produced by the bacteria on various cell culture and live animals.

**Suggested Readings**

Selected articles from journals.

**VMC 706: ADVANCES IN VIROLOGY****2+1****Objective**

Advanced study of virus structure, their nucleic acids and proteins; latest trends in animal virus research.

**Theory****UNIT I**

Biology of RNA and DNA virus replication.

**UNIT II**

Current concepts in animal virus research with respect to viral structure and architecture, viral virulence, viral pathogenesis, persistence and oncogenesis.

**UNIT III**

Latest trends in the development of antivirals.

**UNIT IV**

Cloning and expression in viral vectors.

**Practical**

Separation and characterization of viral proteins, and nucleic acid by polyacrylamide gel electrophoresis, column chromatography, blotting techniques. Problem oriented practical assignments aimed at development of bioreagents and relevant diagnostic tests. Screening and evaluation of antiviral agents for efficacy and toxicity.

**Suggested Readings**

Selected articles from journals.

**VMC 707: MOLECULAR AND GENETIC ASPECTS OF VIRAL PATHOGENESIS****2+1****Objective**

To study molecular and genetic determinants of viral virulence and pathogenesis; animal models for studying viral pathogenesis.

**Theory****UNIT I**

Mechanisms of viral infection and spread through the body; detailed study of virus host interactions.

**UNIT II**

Host immune responses to viral infections; viral strategies to evade host immune responses.

**UNIT III**

Pathogenesis of viral diseases of various systems; animal models for studying viral pathogenesis; molecular and genetic determinants of viral virulence; mechanisms of viral virulence.

**UNIT IV**

Molecular and genetic determinants of viral persistence, viral oncogenesis, viral immunosuppression, and immunopathology. Animal models for studying viral pathogenesis.

**Practical**

Pathotyping of animal viruses using Newcastle disease virus as model; Determination of immunosuppressive potential of animal viruses using infectious bursal disease virus/ Marek's disease virus/ chicken anemia virus; characterization of molecular determinants of viral virulence using variants, recombinants and reassortants; isolation and molecular characterization of viruses with varying virulence.

**Suggested Readings**

Selected articles from journals.

**VMC 708: STRUCTURE FUNCTION RELATIONSHIP OF DNA AND RNA VIRUSES****3+0****Objective**

To understand the relationship between structure and function of DNA and RNA viruses of animals for the development of next generation viral vaccine and antivirals.

**Theory****UNIT I**

Methods of studying virus structure and architecture; methods of amplification of viral nucleic acids; molecular characterization of viral protein and nucleic acid, nucleotide sequencing, and its analysis by software programmes.

**UNIT II**

Detailed study of virus replication in various groups of animal viruses.

Understanding the relationship between structure and function of animal DNA and RNA viruses, development of modern vaccines and antivirals using the relationship between structure and function of animal DNA and RNA viruses.

**Suggested Readings**

Selected articles from journals.

**VMC 709: ONCOGENIC VIRUSES****2+0****Objective**

To study mechanisms of viral oncogenesis.

**Theory****UNIT I**

General features of cell transformation and characterization of transformed cells; Oncogenic RNA and DNA viruses; expression of viral and cellular oncogenes.

**UNIT II**

Mechanisms of viral oncogenesis; Diagnosis of viral oncogenesis.

**Suggested Readings**

Selected articles from journals.

**VMC 710: SLOW VIRAL INFECTIONS AND PRIONS****2+0****Objective**

To study slow viral infections; properties and replication of prions, and diseases caused by them.

**Theory****UNIT I**

Epidemiology, pathogenesis, diagnosis and control of slow viral infections.

**UNIT II**

Properties, replication and epidemiology of prions. Pathogenesis, immunity, diagnosis and control of various diseases caused by prions; recent trends in prion research.

**Suggested Readings**

Selected articles from journals.

**VMC 711: MOLECULAR IMMUNOLOGY****2+1****Objective**

To familiarize with advances in research on immune system molecules such as antigens, antibodies, complement, cytokines, surface molecules, etc.

**Theory****UNIT I**

Pathogen associated molecular patterns and pattern recognition receptors in immunity. Advances in characterization of antigens and superantigens, epitope mapping. Novel functions of immunoglobulins and their fragments produced by rDNA technology.

**UNIT II**

Cytokines and cytokine receptors: structure and function. Complement components genes and polymorphism. MHC genes. Evolutionary aspects of recombination activating genes-mediated immunity in vertebrates.

Immunoinformatics as applied to MHC molecules-peptide complexes and other molecules. Immunomics.

**Practical**

Purification of immunoglobulin classes and IgG subclasses, IgG fragments production by pepsin and papain digestion, cytokine quantitation and detection by ELISPOT assay, IgV gene amplification and sequencing, use of immunoinformatic tools to Ig genes.

**Suggested Readings**

Selected articles from journals.

## VMC 712: ADVANCES IN CELLULAR IMMUNOLOGY

2+1

### Objective

To learn advances in research on immune cell biology and cellular interactions in immune responses.

### Theory

#### UNIT I

Hematopoietic stem cells and differentiation pathways of various leukocytes. B and T lymphocyte repertoires. Lymphocyte-endothelial cell interactions during lymphocyte emigration and recirculation. Antigen presenting cells, T cell subsets, regulatory T cells, memory B and T cells. NK cell biology.

#### UNIT II

Cellular interactions during immune response development: microenvironments, antigen processing and presentation, activation of B and T cells, co-stimulatory molecules, cytokines in intercellular communication. Signal transduction pathways in B and T cell activation.

#### UNIT III

Immunoregulation of B and T cell response. Mucosal immune system. Oral tolerance and its breakdown. Advances in transplantation immunology. SCID, gene-knockout and transgenic animals in immunobiology research.

### Practical

Fluorescence activated and magnetic cell sorting of lymphocyte subsets, Lymphocyte proliferation assays using non-radioisotope methods, adoptive transfer of lymphocyte subsets, cytotoxic T cell assays, ELISPOT assays for enumeration of lymphocyte subsets secreting cytokines.

### Suggested Readings

Selected articles from journals.

## VMC 713: CYTOKINES AND IMMUNOMODULATORS

2+0

### Objective

To learn about structure and function of various cytokines and other immunomodulators.

### Theory

#### UNIT I

Cytokines and immunomodulators: definitions and classification. Cytokines structure and functions. Cytokine receptors: structural types and presence on different cells. Roles in activation, division and differentiation of immune cells, and immunoregulation.

#### UNIT II

Cytokine networks. cytokines in reproductive processes and neuro-endocrino- immunological interactions. Immunomodulators in control of diseases. Cytokines as adjuvants and immunomodulators. Colony stimulating factors and other cytokines in stem cell research.

### Suggested Readings

Selected articles from journals.

## VMC 714: ADVANCES IN VACCINOLOGY

2+0

### Objective

To learn about advances in vaccine research and modern approaches to vaccine development.

### Theory

#### UNIT I

Advances in vaccine development research. Antigen identification and characterization employing newer molecular technologies such as microarrays, *in vivo* expression technology, signature-tagged mutagenesis and phage display technology, etc.

#### UNIT II

Immunoinformatics as applied to epitope mapping, T cell epitopes, identification of pathogenic epitopes, etc. Novel vaccines: nucleic acids, marker vaccines, mucosal vaccines, bacterial ghosts as vaccines, virus-like particles. Futuristic vaccines: anti-allergic, anti-autoimmune diseases, de-addiction vaccines, transplant survival/ prolonging vaccines etc.

### Suggested Readings

Selected articles from journals.

## VMC 715: ADVANCES IN IMMUNODIAGNOSTICS

1+1

### Objective

To learn and employ modern approaches to immunodiagnosis.

### Theory

Newer methods of immunodiagnosis: simple, rapid, precise immunodiagnostic tests such as immunochromatofocussing, immunofiltration tests, etc. Development of highly sensitive enzyme immunoassays such as immuno-PCR, use of luminescent substrates, etc. Discriminant immunoassays for differentiating cross-reactive antigens. Antibodies in biosensors.

### Practical

Development of immunofiltration test using monoclonal antibody for diagnosis of any veterinary infectious disease. Blocking ELISA to differentiate cross-reactive antigens.

### Suggested Readings

Selected articles from journals.



**VMC 716: MODERN IMMUNOTECHNOLOGY****1+2****Objective**

To provide training on production of monoclonal antibody and other immunobiologicals by various modern methods.

**Theory****UNIT I**

Historical developments in modern immunotechnology. Hybridoma technology: advances in monoclonal antibody production. Chimeric and humanized monoclonal antibodies.

**UNIT II**

Recombinant DNA technology for expression of antibody fragments: Fab, scFv, bispecific antibody, nanobody and various other antibody formats. Modern uses of antibody fragments: biosensors, catalysis, therapeutics, *in vivo* imaging, microarrays, proteomics, etc.

**Practical**

Production of murine monoclonal antibody against antigens of infectious agents by hybridoma technique. Production of phage display library of scFv or camel nanobody. Selection of antigen-specific phage displayed antibody fragment by panning or other techniques.

**Suggested Readings**

Selected articles from journals.

**VMC 717: CURRENT TOPICS IN INFECTION AND IMMUNITY****3+0****Objective**

Discussions on recent developments in the immunobiology of major viral, bacterial and fungal diseases of animals.

**Theory****UNIT I**

Introduction and historical developments. Host-pathogen relationship.

**UNIT II**

Effector mechanisms of specific and non specific immunity to different groups of microbes.

**UNIT III**

Immunobiology of major viral, bacterial and fungal diseases of animals. Types of vaccines in infectious diseases and current trends in vaccine development.

**Suggested Readings**

Selected articles from journals.

**VMC 718: VETERINARY MICROBIAL BIOTECHNOLOGY****2+1****Objective**

To understand as to how microbial processes and activities can be used for development of medically and industrially important products and processes.

**Theory****UNIT I**

History of microbial biotechnology. Microbes in nature. Microbes as infectious agents of human and animals. Host-microbe relationships. Microbial metabolism and growth characteristics. Microbial genetics.

**UNIT II**

Introduction to molecular biology of microorganisms: DNA, RNA and proteins structure and functions. DNA replication, RNA transcription, reverse transcription, protein translation, regulatory mechanisms. Bacterial extrachromosomal DNA elements.

**UNIT III**

Genetic engineering: restriction enzymes, DNA ligases, DNA polymerases, RNases and DNases, other enzymes. DNA sequencing. Plasmids and phage-derived vectors, bacterial hosts for cloning and expression of transgenes. Genomic libraries and sequencing. Blotting of DNA, RNA and proteins. Polymerase chain reaction. Microarrays. Metagenomics.

**UNIT IV**

Expression of antigens and antibody fragments useful as diagnostic reagents and vaccines. PCR and blotting techniques in infectious disease diagnosis. Nucleic acid vaccines. Vectored viral and bacterial vaccines. Construction of defined mutants and marker vaccines using genetic manipulation techniques. Display technologies for production of immunobiologicals. Manipulation of microbial processes for production of industrially useful substances.

**Practical**

Extraction of nucleic acids from viruses and bacteria. Restriction endonuclease digestion of DNA and resolution in agarose gel electrophoresis. PCR amplification of DNA. RT-PCR of RNA. Insertion of DNA fragments into plasmid/phagemid/phage vectors. Construction of competent *E. coli* host cells. Transformation and transfection of competent *E. coli* cells. Screening of transformants and isolation of clones. DNA sequencing of clones/PCR amplicons. Expression of genes of bacterial/viral antigens. Use of PCR for infectious disease diagnosis.

**Suggested Readings**

Selected articles from journals.

**VMC 790: SPECIAL PROBLEM****0+2****Objective**

To provide expertise in handling practical research problem(s).

**Practical**

Short research problem(s) involving contemporary issues and research techniques.

### **List of Journals**

- \* Advances in Immunology
- \* Advances in Virus Research
- \* Annual Review of Immunology
- \* Current Topics in Microbiology and Immunology
- \* Immunology
- \* Indian Journal of Virology
- \* Infection and Immunity
- \* Journal of Bacteriology
- \* Journal of General Virology
- \* Journal of Immunology
- \* Journal of Virology
- \* Nature
- \* Nature Immunology
- \* Nature Reviews Immunology
- \* Science
- \* Trends in Biotechnology
- \* Trends in Immunology
- \* Vaccine
- \* Veterinary Immunology and Immunopathology
- \* Veterinary Microbiology
- \* Virology

### **e-Resources**

- \* [www.virology.com](http://www.virology.com) (Virology Journal)
- \* [www.elsevier.com/locate/vetmic](http://www.elsevier.com/locate/vetmic) (Veterinary Microbiology)
- \* [www.jb.asm.org](http://www.jb.asm.org) (Journal of Bacteriology)
- \* [www.jac.oxford.journals.org](http://www.jac.oxford.journals.org) (Clinical Bacteriology)
- \* [www.bentham.org/open/tomycj](http://www.bentham.org/open/tomycj) (The Open Mycology Journal)
- \* [www.nature.com/nrmicro](http://www.nature.com/nrmicro) (Nature Review of Microbiology)
- \* [www.trends.com/tim](http://www.trends.com/tim) (Trends in Microbiology)
- \* [www.arjournals.annualreviews.org/loi/micro](http://www.arjournals.annualreviews.org/loi/micro) (Annual Reviews of Microbiology)
- \* [www.jcm.asm.org](http://www.jcm.asm.org) (Journal of Clinical Microbiology)
- \* [www.trends.com/it](http://www.trends.com/it) (Trends in Immunology)
- \* [www.arjournals.annualreviews.org/loi/immunol](http://www.arjournals.annualreviews.org/loi/immunol) (Annual Reviews of Immunology)
- \* [www.elsevier.com/locate/vaccine](http://www.elsevier.com/locate/vaccine) (Vaccine)
- \* [www.nature.com/immunol](http://www.nature.com/immunol) (Nature Review of Immunology)
- \* [www.iac.asm.org](http://www.iac.asm.org) (Infection and Immunity)
- \* [www.jaonline.com](http://www.jaonline.com) (Journal of Allergy and Clinical Immunology)
- \* [www.elsevier.com/locate/molimm](http://www.elsevier.com/locate/molimm) (Molecular Immunology)
- \* [www.blackwellpublishing.com/journals/pim](http://www.blackwellpublishing.com/journals/pim) (Parasite Immunology)
- \* [www.jleukbio.org](http://www.jleukbio.org) (Journal of Leucocyte Biology)
- \* [www.ocw.mit.edu](http://www.ocw.mit.edu) (MIT Open Course Ware/Health Sciences and Technology)

### **Professional Course Ware Web Sites:**

- \* [www.jbpub.com](http://www.jbpub.com)
- \* [www.bact.wisc.edu](http://www.bact.wisc.edu)
- \* [www.textbookbacteriology.net](http://www.textbookbacteriology.net)
- \* [www.mhhe.com/Prescott5](http://www.mhhe.com/Prescott5)
- \* [www.Highwirepress.stanford.edu](http://www.Highwirepress.stanford.edu)
- \* [www.vibno/Epid/supercourseforvirology](http://www.vibno/Epid/supercourseforvirology)

### **Suggested Broad Topics for Master's and Doctoral Research**

- \* Isolation, identification and characterization of pathogenic bacteria for developing diagnostics and vaccines
- \* Development of genetically modified bacteria for improved vaccine and genetically modified signaturred bacteria for developing vaccine candidate that can differentiate vaccinated from infected animals
- \* Development of molecular tools for studying evolution, quick diagnosis and molecular epidemiology of microbes
- \* Molecular characterization and antigenic relationship of field isolates of important viruses of animals and poultry.
- \* Isolation and characterization of field isolates of important viruses of livestock and poultry with the aim of development of diagnostics and candidate vaccines
- \* Studies on immune responses and immunity to animal and poultry viruses
- \* Investigation of the roles of proinflammatory cytokines in ovarian activity of buffaloes
- \* Production of phage display libraries of bovine scFv for diagnostic and therapeutic uses

\* Development of novel delivery systems for developing mucosal veterinary vaccines