Veterinary Microbiology

Courses Offered:

UG (B.V.Sc & A.H.):

LECTURE SCHEDULE AS PER MSVE - 2016

SUBJECT - VETERINARY MICROBIOLOGY

THEORY

Sr. No.	Unit No.	Particulars
1	I	Introduction and history of Microbiology, Highlights of developmental history of Veterinary Microbiology, Scope of Veterinary Microbiology
2	I	Classification and nomenclature of bacteria, Unicellular organisms- Prokaryotes and Eukaryotes, Kingdom Prokaryote and its four division (Bergey's Manual of Systematic Bacteriology), Basis of classification and nomenclature of microorganisms
3	I	Microscopy and Micrometry: Lenses and the Bending of Light, The Light Microscope, Newer Techniques in Microscopy
4	I	Bacterial stains and techniques: Preparation and Staining of Specimens, Dyes and Simple Staining, Differential Staining, Special staining, Structure and morphology of bacteria. Morphology: Shape, size, arrangement and morphological variations. Structure: Structure of bacterial cell, cell wall, cytoplasmic membrane, cytoplasm, ribosome, mesosomes, chromatin material, Capsule, flagella, fimbriae, endospore, plasmids, inclusions (volutin / metachromatic granules etc).
5	I	Growth and nutritional requirement of aerobic and anaerobic bacteria. Growth requirements: Temperature, pH, gases (oxygen, carbon dioxide etc), moisture etc. Nutrition: Nutritional types (Autotrophs, heterotrophs, phototrophs, lithotrophs etc), Nutrient requirements (Macro and micronutrients)
6	I	Normal, opportunistic and saprophytic bacterial flora: Types and sources of infection, method of transmission of infection, Transmission of infection- Modes of transmission, direct & indirect contact etc., Sources of infection-animal, human, insects, inanimate objects
7	I	Pathogenicity, virulence, determinants of virulence, Factors determining the ability of organism to produce disease, pathogenicity, virulence, invasiveness, toxigenicity, Resistance and susceptibility of host, Host factors- breed, species, individual factors- age, physiological & nutritional status, use of antibiotics or corticosteroids etc, Epizootic and enzootic diseases
8	I	Bacteremia, septicaemia and toxaemia, endotoxins, exotoxins, antitoxins, toxoids
9	I	Bacterial genetics (Mutation, Transformation, Transduction and Conjugation), plasmids and antibiotic resistance, Phenotypic and Genotypic variations, Chromosomal DNA, plasmids, F factor, Col factor, R Factor, Methods of transmission of genetic material in microorganisms: Transformation, Transduction, Conjugation etc
10	I	Antibiotic resistance: Genetic mechanisms, mutational, plasmid-mediated
11	I	*Staphylococcus aureus (*Short description of *Staphylococcus hyicus, Staphylococcus intermedius, Staphylococcus epidermidis)*
12	I	Streptococcus (*Streptococcus pyogenes, Streptococcus equi, Streptococcus agalactiae, Streptococcus dysgalactiae, Streptococcus uberis)*
13	I	Genus: *Corynebacterium (Corynebacterium pseudotuberculosis, Corynebacterium bovis and Rhodococcus equi)*

14	I	Genus-Trueperella (*Trueperella pyogens, Trueperella spp.)*
15	I	*Listeria monocytogens, Listeria ivanovii* and *L. inocua*
16	I	*Erysepelothrix rhusiopathiae*
17	I	Genus: *Bacillus (Bacillus anthracis*, Short description of anthrociodes -*Bacillus subtis* and *Bacillus cereus)*
18	I	Genus: *Mycobacterium (Mycobacterium tuberculosis, Mycobacterium bovis, Mycobacterium avium)*
19	I	*Mycobacterium avium* subsp. *Paratuberculosis*
20	I	Genus: *Clostridum (*Types of Clostridia - Histotoxic, Neurotoxic, Hepatotoxix, Enteropathogenic etc. Clostridium chauvoei, Clostridium perfringens)
21	I	*Clostridium tetani, Clostridium botulinum,* Short description of other Clostridia
22	I	Genus: *Actinomyces (Actinomyces bovis, Actinomyces viscosus, Actinomyces hordeovulneris, Actinobaculum suis,Arcanobacterium pyogens) Genus:Nocardia (Nocardia farcinica, Nocardia asteroides)Streptomyces and Dermatophilus congolensis*
23	I	Enterobacteriaceae family (*E.coli, Klebsiella pneumoniae, Salmonella, Yersinia pestis, Proteus mirabillis, Proteus vulgaris)*
24	I	*Pseudomonas aeuriginosa* and *Burkholderia mallei, B. pseudomallei*
25	I	*Pasteurella multocida, Mannheimia hemolytica*
26	I	*Actinobacillus lignieresii*
27	I	*Histophillus somni, Haemophilus parasuis, Avibacterium paragallinarum, Taylorella equigenitalis*
28	I	*Brucella abortus, B. melitensis*, and other brucella spp.short description
29	I	*Vibrio cholera*
30	I	*Campylobacter fetus* sub spp. *fetus, Campylobacter fetus* sub spp. *veneralis, C. jejuni*
31	I	*Bordetella bronchiseptica* and *Moraxella bovis*
32	I	Gram negative anaerobes: *Bacteriodes fragilis, Dichelobacteria nodosus* and *Fusobacterium necrophorum*
INTERNAL ASSESSMENT I		
33	I	Leptospira borgpeterseni serovar Hardjo , L. inetrrogans serovar Hardjo, and other Spirochaetes (Brachyspira, Borrelia anserina)
34	I	*Mycoplasma mycoides* sub spp. *mycoides, Mycoplasma bovis, Mycoplasma capricolum* sub spp. *capripneumoniae, M. gallisepticum, and other mycoplasma spp. short description*
35	I	*Coxiella burnetti*, Neorickettsia, *Ehrlichia ruminatium,*
36	I	Anaplasma, Rickettsia
37	I	*Chlamydia trachomatis, C. suis and Chlamydophila psittaci, C. abortus C. pecorum*
38	I	Emerging bacterial pathogens
39	I	Re-emerging bacterial pathogens
40	I	Transboundry bacterial pathogens
41	II	Introduction, History, Scope of Mycology and Classification of Mycoses
42	II	General properties of fungi, Growth, Nutrition and Reproduction of fungi
43	II	Study in relation to cultural isolation, growth, morphological, biochemical and antigenic characteristics as well as epidemiology, pathogenesis, diagnosis and control of fungal diseases caused by the genera:
44	II	Candida and Cryptococcus

45	II	Aspergillus and Penicillium
46	II	Dermatophytes and Malassezia
47	II	Rhinosporidium and Sporotrichum
48	II	Mycetoma and Zygomycetes
49	II	Mycotic mastitis, Mycotic abortion and Mycotoxicoses
50	III	Basic concepts and scope of Recombinant DNA technology
51	III	Gene cloning, Cloning vectors and expression vectors
52	III	Transformation and transfection
53	III	Southern, Northern and Western blotting
54	III	Bioinformatics, Gene banks
55	III	Application of molecular and biotechnological techniques: Polymerase chain reaction, Nucleic acid hybridization
56	III	DNA library
57	III	DNAsequencing
58	III	DNA fingerprinting
59	III	IPR
60	III	Ethics and regulatory issues in Animal Biotechnology
61	IV	Historical development of immunology
62	IV	Lymphoid organs: Central and peripheral lymphoid organs, Cells involved in immunity: Lymphocytes: T and B lymphocytes, macrophages, neutrophils, NK Cells, Dendritic cells etc.
63	IV	Types of Immunity, Immunity: Definition, types of immunity- innate immunity, mechanisms of innate immunity (non-specific defense, Acquired immunity – active and passive immunity, (Immune response: Humoral and cellular immune response; Primary and secondary immune response)
64	IV	Antigen: Definition, properties and types of antigen (T dependent and T independent Antigens, heterophile Antigens, cross reacting Antigens), specificity of antigens, blood group antigens, Antigenic determinant / epitope, Mitogens and factors affecting immunogenicity, Adjuvants
INTERNAL ASSESSMENT II		
65	IV	Antibody: Structure, properties and functions of different classes of immunoglobulins. Theories of antibody production; Hybridoma technique and monoclonal antibodies.
66	IV	Serological reactions: Antigen-antibody reactions: General features of antigen-antibody reactions, antibody affinity, avidity, specificity; forces binding antigen and antibody, Principle and applications of : Precipitation, agglutination reactions; complement fixation, neutralization
67	IV	Serological reactions: Principle and applications of : cytolysis, toxin-antitoxin neutralization, immunofluorescence, enzyme immunoassays, phagocytosis, opsonic index
68	IV	Major histocompatibility complex (MHC) structure, function and gene organization; Structure of BCR and TCR
69	IV	Antigen processing and presentation
70	IV	Complement system: Activation pathways and biological consequences
71	IV	Cytokines: general properties, major types and function
72	IV	Hypersensitivity: Definition, types of hypersensitivity- immediate and delayed hypersensitivity, mechanisms of different types of hypersensitivity reactions
73	IV	Autoimmunity: Definition, mechanisms, classification of autoimmune disorders. Immunological tolerance.

74	IV	Concept of Immunity to Microbes, Vaccines and other biological. Biologicals: Vaccines – inactivated, live and modern vaccines their advantages and disadvantages, adjuvants, quality control of vaccines
75	V	Introduction and History : Highlights of developmental history of veterinary virology. General properties of virus, comparison of viruses & other microorganisms, definition of different terms.
76	V	Structure of Viruses : Morphology & Structure of viruses - shape, size, symmetry, capsid, envelope, pepleomers etc. Chemical composition of viruses – nucleic acid, proteins, lipids, carbohydrates, Resistance of virus to physical and chemical agents.
77	V	Classification of viruses : Taxonomy and nomenclature of viruses, Criteria used in classification of viruses, Classification of viruses, Subviral agents, Prion's etc.
78	V	Replication of viruses: Single step growth curve, essential steps involved in multiplication. Replication of DNA viruses. Replication of RNA viruses.
79	V	Genetic and Non-genetic viral interaction : Mutation, recombination, genetic reassortment and reactivation. Transcapitation, complementation, phenotypic mixing and polyploidy.
80	V	Virus – cell interactions & Viral Pathogenesis : Types of interactions, Cytocidal changes in virus infected cells, mechanisms of cell damage. Noncytocidal changes in virus infected cells, Inclusion bodies. Route of entry and its impact, Host specificity, tissue tropism, Spread, Mechanism of targeting specific tissues and organs, mechanism of virus shedding.
81	V	Oncogenesis: Cell transformation, Oncogenes and oncoproteins, Mechanism of activation of Cellular oncogenes by virus infection.
82	V	Latency and Immunopathology: Viral persistence, viral strategies to evade host defense mechanisms, persistent infection and chronic damage to tissues and organs, Immunopathology of viral infections, infection induced damage to immune system, autoimmune disease, hypersensitivity.
83	V	Birnaviridae: Infectious bursal diseases
84	V	Reoviridae: Rotaviruses, Bluetongue virus, African horse sickness virus
85	V	Paramyxoviridae: New castle disease virus
86	V	Paramyxoviridae: Canine distemper, PPR virus
87	V	Rhabdoviridae: Rabies virus, Ephemeral fever virus
88	V	Bornaviridae: Borna virus
89	V	Orthomyxovridae: Swine, Equine, Avian influenza viruses
90	V	Coronaviridae: Infectious Bronchitis virus, Transmissible gastroenteritis virus
91	V	Arteriviridae: Equine viral arthritis virus
92	V	Picornaviridae: FMD virus, Duck viral hepatitis virus
93	V	Caliciviridae: Feline calicivirus
94	V	Togaviridae: Equine encephalomyelitis viruses (WEE, EEE and VEE)
95	V	Flaviridae: Swine fever virus, BVD virus
96	V	Retroviridae: Visina/maedi virus, Equine infectious anemia virus
INTERNAL ASSESSMENT III		
97	V	Retroviridae: Lymphoid leucosis virus, Bovine leukemia virus
98	V	Poxviridae: Capripoxvirus, Avipoxvirus, Cowpoxvirus
99	V	Asfarviridae: African swine fever virus
100	V	Herpesviridae: Bovine herpes viruses, Equine herpes viruses, Pseudorabies virus
101	V	Herpesviridae: Infectious laryngotracheitis virus, Marek's disease virus
102	V	Herpesviridae: Malignant catarrhal fever virus, Duck plague virus

103	V	Adenoviridae: Infectious canine hepatitis virus, Egg drop syndrome virus, Fowl adenovirus
104	V	Papilomaviriade: Papillomatosis
105	V	Parvoviridae:Canine parvoviruses, Feline panleucopenia virus
106	V	Circoviridae: Chicken anemia virus
107	V	Prions: Scrapie, Bovine spongiform encephalopathy
108	V	Emerging, re-emerging & transboundry viruses & viral infection: Equine morbillivirus, Porcine reproductive and respiratory syndrome virus, Nipah, Hanta virus, Ebola and Marburg viruses

PRACTICAL

Sr. No.	Unit No.	Particulars
1	I	Orientation to bacteriology laboratory
2	I	Methods of sterilization and disinfection
3	I	Preparation of culture media for cultivation of aerobic and anaerobic bacteria
4	I	Methods of inoculation, Cultivation of aerobic and anaerobic bacteria
5	I	Isolation of bacteria in pure culture
6	I	Simple staining, Negative staining
7	I	Differential staining procedures of bacteria: Gram's staining
8	I	Differential staining procedures of bacteria : Acid fast staining
9	I	Special staining procedures: Capsule and Spore staining
10	I	Bacterial motility
11	I	Culture sensitivity test
12	I	Outlines of collection, transportation and processing of samples for bacterial disease diagnosis
13	I	Characterization of *Staphylococcus*
14	I	Characterization of *Streptococcus;*
15	I	Characterization of *E. coli*
16	I	Characterization of *Salmonella*
17	I	Characterization of *Klebsiella and Proteus*
18	I	Characterization of *Pseudomonas;*
19	I	Characterization of *Pasteurella*
20	I	Characterization of *Clostridium*
21	I	Isolation and identification of bacteria from clinical cases of Mastitis
22	I	Isolation and identification of bacteria from clinical cases of Abortions
23	I	Isolation and identification of bacteria from clinical cases Enteric infections
24	I	Isolation and identification of bacteria from clinical cases Respiratory infections
25	I	Isolation and identification of bacteria from clinical cases Pyogenic infections
26	II	Collection, transportation, processing of samples and preparation of media for isolation of fungi
27	II	KOH mount, Lactophenol cotton blue staining of moulds and Dermatophytes

28	II	Cultivation, Slide culture technique, Cultural characteristics and Antifungal sensitivity testing of fungi
29	II	Diagnosis of Aspergillosis and Candidiasis
30	II	Demonstration of other important yeast
31	III	Extraction and quantitation of nucleic acid
32	III	Plasmid isolation and plasmid profiling
33	III	Agarose gel electrophoresis for studying or diagnosis of nucleic acid of microbes
34	III	SDS PAGE electrophoresis for studying or diagnosis of proteins of microbes
35	III	Use of Multimedia and audio-visual aids for molecular biology aspects
36	IV	Preparation of antigen Preparation of antigen- formalinized whole cell bacterin, Inoculations of lab animals and raising antisera Raising antiserum against whole cell bacterin
37	IV	Separation and preservation of serum; Concentration of Immunoglobulins
38	IV	Agglutination reactions: Plate / slide agglutination test , Standard tube agglutination test
39	IV	Agglutination reactions contd.: Haemagglutination and haemagglutination-inhibition tests, Indirect / passive haemagglutination test
40	IV	Precipitation reactions : Agar gel immunodiffucsion test (AGID) , Radial immunodiffusion (RID), Counter immunoelectrophoresis (CIE), Rocket immunoelectrophoresis (RIE)
41	IV	Cell mediated immune response (DTH)
42	IV	Enzyme linked immunosorbent assay (ELISA) Direct , indirect, sandwich, dot-ELISA
43	IV	Visit and appraisal of Veterinary biological institute
44	V	Collection , preservation, transport of clinical samples & processing of material for virus isolation.
45	V	Isolation & cultivation of viruses in laboratory animals / poultry
46	V	Isolation of viruses in embryonated eggs. (Chick embryo inoculation & harvesting of virus)
47	V	Media & reagent preparation for cell culture
48	V	Subculture & maintenance of continuous cell lines
49	V	Quantitation of cells by viable cell counts in a haemocytometer
50	V	Cryopreservation & recovery of cell culture
51	V	Primary cell culture embryo fibroblast / lamb kidney
52	V	Infection of cell cultures with virus & study of cytopathic effects- Demonstration
53	V	Titration of virus by $TCID_{50}$ & plague assay in cell culture
54	V	Serum neutralization test in cell cultures for detection of neutralizing antibodies- Demonstration
55	V	Agar gel precipitation test for detection of viral infection
56	V	Haemagglutination and haemagglutination inhibition test for Newcastle disease virus
57	V	ELISA for detection of viral antigen and antibodies
58	V	Molecular techniques for viral disease diagnosis

PG (M.V.Sc):

Semester wise Distribution of Courses

S. No.	Course No.	Title	Credits
		SEMESTER I	
1	VMC 501	General Bacteriology*	2+1=3
2	VMC 503	General Virology*	2+1=3
3	VMC 508	Techniques in Microbiology	0+2=2
4	VMC 509	Techniques in Molecular Microbiology	1+2=3
		Total compulsory courses	**4+2=6**
		SEMESTER II	
1	VMC 502	Systematic Veterinary Bacteriology	2+1=3
2	VMC 504	Systematic Veterinary Virology	2+1=3
3	VMC 505	Principles of Veterinary Immunology*	2+1=3
4	VMC 506	Veterinary Mycology*	1+1=2
		Total compulsory courses	**3+2=5**
		SEMESTER III	
1	VMC 507	Vaccinology	2+0=2
2	VMC-510	Molecular Immunology	1+1=2
3	VMC-511	Mucosal Immunology	1+0=1
4	VMC 512	Introduction to Microbial Bioinformatics	1+0=1
5	VMC 591	Master's Seminar*	1+0=1
6	VMC 599	Master's Research*	0+10=10
7	PGS 601	Technical Writing & Communication Skills*	0+1=1
8	PGS 602	Agricultural Research, Research Ethics & Rural* Development Programmes*	1+0=1
9	PGS 603	Basic concepts in Laboratory Techniques*	0+1=1
10	PGS 604	Intellectual Property & its management*	1+0=1
11	PGS 605	Library & Information Services*	0+1=1
		Total compulsory courses	**3+13=16**
		SEMESTER IV	
1	VMC 599	Master's Research*	0+20=20
		Total compulsory courses	**0+20=20**

***Core/compulsory Courses**

Course Outline-cum-Lecture Schedule
M.V.Sc. Veterinary Microbiology

General Bacteriology

Course Code & Credit Hours	VMC 501 2+1=3	**Title**	General Bacteriology

THEORY

Lecture No.	Topic
	UNIT I
1	Historical events of Microbiology
2	Contribution of eminent scientists, scope and application of microbiology
3	Taxonomy and nomenclature of bacteria
4	Basic principle of microscopy and micrometry
5	Classical and Confocal Microscopy
6	Nomaraski and Electron Microscopy
7	Staining of bacteria
8	Structure and function of bacterial cell: Morphology of bacteria
9	Structure, composition and functions of cell wall, cytoplasmic membrane
10	Structure, composition and functions of cytoplasm, ribosomes, nuclear material, bacterial inclusions
11	Structure, composition and functions of appendages like capsule, flagella, fimbriae
12	Structure, composition and functions of endospores, plasmids etc.
13	Bacterial growth: measurement of bacterial growth, bacterial growth curve
14	Bacterial Physiology and Nutrition: Nutritional types, nutritional and physiological requirements
15	Bacterial metabolism: Bioenergetics, generation of energy and transfer, oxidation-reduction system, membrane transport, electron transport system, aerobic and anaerobic respiration, carbohydrate, protein, lipid metabolism, biosynthesis of macromolecules
16	Secretion systems of bacteria
17	Excretion systems of bacteria
18	General Principles of bacterial disease diagnosis
19	Advances in bacterial disease diagnosis
	UNIT II
20	Bacterial genetics and Bacterial variation
21	Horizontal genetic transfer mechanisms- transformation, transduction and conjugation
22	Plasmids, transposons and drug resistance
	UNIT III
23	Determinants of pathogenicity and its molecular basis: Invasiveness, invasins
24	Determinants of pathogenicity and its molecular basis: toxigenesis, exotoxins and endotoxins and mechanism of their action
25	Determinants of pathogenicity and its molecular basis: adherence, colonization

26	Determinants of pathogenicity and its molecular basis: evasion of host defenses
27	Markers and PAMPs, exotoxin and endotoxin
28	Bacteriophages- temperate and virulent phages
29	Bacteriophages- lysogeny and lysogenic conversion
30	Antimicrobial agents: Classes of antimicrobials
31	Antimicrobial agents: Mechanism of action
32	Disinfectants -Mechanism of action
33	Disinfectants -Classification
34	Disinfectants -resistance and susceptibility testing
35	Bacterial immunity: to extracellular bacteria
36	Bacterial immunity: to intracellular bacteria

PRACTICAL

Practical No.	Practical
1	Orientation to a bacteriology laboratory
2	Different sterilization techniques: Physical methods
3	Disinfection techniques: Chemical, biological methods
4	Laboratory biosafety and biosecurity
5	Cultivation of aerobic, microaerophilic bacteria
6	Cultivation of anaerobic bacteria
7	Isolation of bacteria in pure culture: using dilution method, various inoculation techniques etc
8	Isolation of bacteria in pure culture: using different substances or indicators in media and biological methods
9	Microscopy
10	Morphological characterization of bacteria by different staining methods viz. Simple staining, differential staining
11	Morphological characterization of bacteria by different staining methods viz. Negative staining, special staining etc
12	Important biochemical tests for identification of bacteria: carbohydrate, protein and lipid metabolism tests
13	Important biochemical tests for identification of bacteria: sugar and miscellaneous tests
14	Determination of bacterial number and biomass by different methods
15	Determination of bacterial number and biomass by different methods (contd..)
16	Standard protocols for antibiotic sensitivity test: Disc diffusion method
17	Detection of MIC: Resazurin microtiter assay
18	Detection of MIC: Broth microdilution method

Suggested Readings:

- B Markey, F Leonard, M Archambault, A Cullinane and D Maguire. 2013. Clinical Veterinary Microbiology 2nd Ed. MOSBY- Elsevier.
- C Hirsh, NJ MacLachlan and RL Walker. 2004. Veterinary Microbiology, 2ndEdn., Wiley Blackwell Pub.

- GJ Tortora, BR Funke, CL Case, D Weber and W Bair. 2018. Microbiology: An Introduction, 13th Ed., Pearson Pub.
- J Willey, K Sandman and D Wood. 2019. Prescott's Microbiology, 11thEdn., McGraw-Hill Education Pub.
- L Gyles, JF Prescott, J Glenn Songer and CO Thoen. 2010. Pathogenesis of Bacterial Infections in Animals, 4thEdn., Wiley-Blackwell Pub.
- PJ Quinn, BK Markey, FC Leonard, P Hartigan, S Fanning and ES Fitzpatrick. 2011. Veterinary Microbiology and Microbial Disease, 2nd Ed., Wiley-Blackwell Pub.
- S.K. Singh. Veterinary Bacteriology. Edition: 1, 2017. Publisher: Anmol Publications Pvt. Ltd.
- Whitman, W.B., Goodfellow, M., Kämpfer, P., Busse, H.-J., Trujillo, M.E., Ludwig, W. & Suzuki, K.-i. (eds., 2012). Bergey's Manual of Systematic Bacteriology, 2nd ed., vol. 5, parts A and B, Springer-Verlag, New York, NY.
- Harris Russel. 2019. Bacteriology. Publisher: Callisto Reference.

Systematic Veterinary Bacteriology

Course Code & Credit Hours	VMC 502 2+1=3	**Title**	Systematic Veterinary Bacteriology

THEORY

Lecture No.	**Topic**
	UNIT I
1 2	Spirochetes: Leptospira Spirochetes: Brachyspira and Borrelia
3	Campylobacter
4	Bordetella and Morexella
5 6	Brucella Brucella cont.
7	Pseudomonas and Burkholderia
8 9 10	Enterobacteriaceae- *Escherichia coli* Enterobacteriaceae- *Salmonella* spp. and *Shigella* spp. *Proteus*, *Klebsiella* and other members of *Enterobacteriaceae*
11 12	Pasteurella and Mannheimia Pasteurella and Mannheimia cont.
13	Haemophilus
14	Dichelobacter and Fusobacterium
	UNIT II
15	Rickettsia and Chlamydia-Rickettsia
16	Rickettsia and Chlamydia- Chlamydia (Chlamydophila) and Coxiella
17	Staphylococcus
18 19	Streptococcus Enterococcus
20	Bacillus
21 22 23	Gens Clostridium- *Clostridium chauvoei* *Clostridium perfringens* *Clostridium tetani*, *Clostridium botulinum*

24	Other Clostridia
25	Erysipelothrix
26	Listeria
27	Actinomyces
28	Corynebacterium and Truepurella
	UNIT III
29 30 31	Genus *Mycobacterium*, *M. tuberculosis*, *M. bovis* *M. avium* subsp. *Paratuberculosis* Other Mycobacteria Mycobacterium
32 33	Actinomycetes: Nocardia Rhodococcus and Dermatophilus
34 35	Mollicutes (Mycoplasma) Mollicutes (Mycoplasma) contd.
	UNIT IV
36	Emerging and transboundary bacterial pathogens

PRACTICAL

Practical No.	Practical
1	Collection, transport and dispatch of clinical samples from various disease conditions
2	Processing of samples for disease diagnosis
3	Preparation of culture media for cultivation of aerobic and anaerobic bacteria
4	Methods of inoculation
5	Cultivation of aerobic bacteria
6	Isolation of bacteria in pure culture
7	Cultivation of anaerobic bacteria
8	Measurement of bacterial growth: Total count, Turbidometric methods
9	Viable count-standard plate count
10	Identification of the bacteria using staining methods
11	Microscopy
12	Identification of bacteria by biochemical tests
13	Identification of bacteria by biochemical tests contd..
14	Molecular techniques- Polymerase chain reaction
15	Molecular techniques- Polymerase chain reaction contd..
16	Nucleic acid sequence-based amplification
17	Preservation and storage of bacterial cultures
18	Preservation and storage of bacterial cultures contd.

Suggested Readings:

- Prescot LM, Harley JP & Klen DA. 2005. *Microbiology*. Wm. C. Brown Publ.
- C.L. Gyles, J. .F Prescott, J.G. Songer, C.O.
- Thoen. Pathogenesis of Bacterial Infections in Animals. 2004 Wiley

General Virology

Course Code & Credit Hours	VMC 503 2+1=3	Title	General Virology

THEORY

Lecture Nos.	Topics
	UNIT I
1	History of virology
2	Origin and nature of viruses
3	Morphological structure
4	Chemical composition of viruses
5	Nomenclature of viruses
6	Classification of viruses
7	Cultivation and purification of viruses
8	Purifications of viruses
9	Laboratory diagnosis of viral infections: Principles and Objectives of Diagnostic Methods, Collection, Packaging, and Transport of Specimens
10	Laboratory diagnosis of viral infections: Direct Identification of Viruses, Direct Identification of Viral Antigens, Direct Identification of Viral Nucleic Acids, Virus isolation and virus quantification.
11	Viroid and Prions
	UNIT II
12	Replication of DNA viruses: DNA Viral Replication Cycle
13	Replication of DNA viruses: Strategies of Replication DNA virus
14	Replication of RNA viruses: RNA Viral Replication Cycle
15	Replication of RNA viruses: Strategies of Replication dsRNA Virus
16	Replication of RNA viruses: Strategies of Replication ssRNA Virus
17	Genetic interactions between viruses: Mutation, recombination, genetic reassortment and reactivation.
18	Genetic and non-genetic interactions between viruses: Transcapitation, complementation, phenotypic mixing, and polyploidy.
	UNIT III
19	Virus-cell interactions: Types of interactions, Cytocidal changes in virus infected cells, mechanisms of cell damage.
20	Virus-cell interactions: Noncytocidal changes in virus-infected cells, Inclusion bodies.
21	Viral Pathogenesis: Viral Strategies and Host Defence Mechanisms
22	Viral Pathogenesis: Representative Model Diseases
23	Viral persistence: Viral persistence, viral strategies to evade host defense mechanisms, persistent infection, and chronic damage to tissues and organs.
24	Viral Persistence: Immunopathology of viral infections, infection-induced damage to the immune system, autoimmune disease, hypersensitivity.
25	Oncogenic and oncolytic viruses: Terms in Oncogenesis, Cell Transformation,

26	Oncogenic and oncolytic viruses: Retrovirus Oncogenes and Oncoproteins, Activation of Cellular Oncogenes
27	Oncogenic and oncolytic viruses: Tumor Induction by Retroviruses, Tumor Induction by DNA Viruses, Multistep Oncogenesis
28	Epidemiology of viral infections: Computations and Databases, Types of Epidemiologic Investigation, Virus Transmission
29	Epidemiology of viral infections: Mechanisms of Survival of Viruses in Nature, Variations in Disease Incidence Associated with Seasons and Animal Management Practises, Epidemiologic Aspects of Immunity
UNIT IV	
30	Immune response to viruses: Cellular / Sub Cellular Components of the Immune System, Immunologic Memory,
31	Immune response to viruses: Recovery from Viral Infection, Immunity to Reinfection, Passive Immunity
32	Viral vaccines: Types of viral vaccines, Conventional and Modern Vaccines
33	Viral Vaccines: Methods for Enhancing Immunogenicity, Factors Affecting Vaccine Efficacy and Safety
34	Viral vaccines: Passive Immunization, Vaccination Policy / Schedule,
35	Viral chemotherapy: Introduction, Various anti-chemotherapy agents
36	Viral chemotherapy: Mechanism of Chemotherapy agents/ anti-viral agents

PRACTICAL

Practical No.	Practical
1	Orientation to a virology laboratory
2	Preparation of glassware, plasticware, media, and reagents for cell culture
3	Collection, preservation, transport of clinical samples and processing of material for virus isolation.
4	Other items required for virus cultivation
5	Protocols for primary and secondary cell cultures
6	Primary cell culture embryo fibroblast/lamb kidney
7	Maintenance of cell lines
8	Subculture of continuous cell lines
9	Cryopreservation of cells.
10	Recovery of cells after cryopreservation
11	Staining of virus-infected cultured cells
12	Demonstration of inclusion bodies
13	Viable cell counting
14	Cultivation of viruses in embryonated chicken eggs-Part-I
15	Cultivation of viruses in embryonated chkien eggs-Part-II
16	Cultivation of viruses in embryonated chkien eggs and Harvesting of virus-Part-III
17	Virus cultivation in primary cell cultures and cell lines: Infection of cell cultures with virus & study of cytopathic effects - Demonstration.
18	Virus cultivation in primary cell cultures and cell lines: Titration of virus by $TCID_{50}$ & plague assay in cell culture-Demonstration

Suggested Readings:

1. Murphy FA, Gibbs EPJ, Holzmek MK and Studdert MJ. 1999 *Veterinary Virology*. 3rd Ed. Academic Press.
2. Achesons NH. 2006. *Fundamentals of Molecular Virology*. Wiley.
3. Carter J and Saunders V. 2007 *Virology: Principles and Applications*. 1st Ed. Wiley.
4. Knipe Dm, Howley PM, Griffith DE. 2006 *Field Virology*. 5th Ed. Vol. I and II. Lippoincott, Williams and Wilkins
5. Mahy BWJ and Kangaroo HO, 1996. *Virological Methods Manual*. Academic Press
6. Freshney RI. 2005. *Culture of Animal*

Systematic Veterinary Virology

Course Code & Credit Hours	VMC-504 2+1=3	**Title**	Systematic Veterinary Virology

THEORY

Study of following animal viruses belonging to various families with reference to Viral properties, epidemiology, pathogenesis and disease status in India, diagnosis, immunity and control of diseases

Lecture Nos.	**Topics**	
UNIT I: Double and Single stranded DNA virus families		
1	*Poxviridae*	Cowpox, Buffalo pox, Milkers nodule
2		Sheep pox
		Goat pox, Orf
3		Lumpy skin Disease
		Fowl pox, Pox viruses affecting other animals
4	*Asfaviridae*	African Swine fever
5	*Herpesviridae*	Infectious bovine rhinotracheitis, Bovine malignant catarrhal fever
6		Equine abortion, Equine Rhinopneumonitis, Equine coital exanthema
7		Infectious laryngotracheitis, Duck plague
		Marek's disease
8		Pseudorabies, Herpesviruses affecting other animals
9	*Adenoviridae*	Infectious canine Laryngotracheitis
		Avian adenoviruses, egg drop syndrome
10		Equine adenovirus
		Inclusion body hepatitis, Leechi disease
11	*Papilomaviridae*	Bovine Papilloma virus type 1 ,2,3,4,5 and 6,
		Canine Papilloma, Equine Papilloma
12	*Polyomaviridae*	Merked cell polyomavirus infection of Animal., dermal fibroblasts

13	*Parvoviridae*	Canine parvovirus
		Porcine parvovirus (SMEDI), Feline Panleukopenia
14	*Circoviridae*	Psittacine beak and feather disease, Chicken anaemia virus disease
15	*Hepdnaviridae*	Hepatitis B
UNIT II: Single stranded Negative sense and Double stranded RNA viruses		
16	*Orthomyxoviridae*	Swine Influenza, Avian Influenza virus
17	*Paramyxoviridae*	Rinderpest
		Peste des petits ruminants
18		Canine distemper
		New castle disease
19	*Rhabdoviridae*	Rabies
20		Vesicular stomatitis, Bovine Ephemeral fever
21	*Bornaviridae*	Borna disease virus (BDV)
22	*Reoviridae*	African Horse Sickness
23		Bluetongue
		Rotaviruses
24	*Birnaviridae*	Infectious bursal disease
UNIT III: Single Stranded Positive sense RNA viruses		
25	*Picornaviridae*	Foot-and-mouth disease
26		Duck hepatitis, Avian encephalomyelitis
27	*Calciviridae*	Vesicular Exanthema virus (VEV)
28	*Togaviridae*	Swine fever
		Bovine viral diarrhoea
29	*Flaviviridae*	Equine encephalitis (WEE,VEE and EEE)
		Japanese B Encephalitis
30	*Coronaviridae*	Infectious Bronchitis
		Transmissible Gastroenteritis
31	*Arteviridae*	Equine arteritis, Porcine Respiratory and Reproductive Syndrome
32	*Astroviridae*	Astrovirus gastroenteritis
33	*Retroviridae*	Avian leucosis
		Equine infectious anaemia
		Bovine leukemia, Visna/maedi
UNIT IV: Prions		
34	Slow virus / prions diseases	BSE
35	Slow virus / prions diseases	Scrapie and Introduction to viriods
	UNIT V:	

36	Emerging, re-emerging and transboundary viral pathogens

PRACTICAL

Practical No.	Practical
1	Collection of clinical samples for virus isolation and identification
2	Preservation of clinical samples for virus isolation and identification
3	Transportation of clinical samples for virus isolation and identification
4-5	Processing clinical samples for virus isolation and identification
6-8	Isolation and cultivation of viruses from clinical samples using egg inoculation
9-11	Isolation and cultivation of viruses from clinical samples using cell cultures/ lines.
12	Plaque purification of viruses
13	Titration of viruses for 50% end points using different methods
14	Detection of viral antibodies by Serum neutralization test
15	Electrophoresis
16	Concentration and purification of animal viruses by chemical agents, differential centrifugation, density gradient centrifugation and ultra -filtration
17	Concentration and purification of animal viruses by differential centrifugation, density gradient centrifugation and ultra -filtration
18	Methods for preservation of animal viruses

Suggested Readings:

Murphy FA, Gibbs EPJ, Holzmek MK and Studdert MJ. 1999 *Veterinary Virology*. 3rd Ed. Academic Press.
Achesons NH. 2006. *Fundamentals of Molecular Virology*. Wiley.
Carter J and Saunders V. 2007 *Virology: Principles and Applications*. 1st Ed. Wiley.
Knipe Dm, Howley PM, Griffith DE. 2006 *Field Virology* . 5th Ed. Vol. I and II. Lippoincott, Williams and Wilkins
Mahy BWJ and Kangaroo HO, 1996. *Virological Methods Manual*. Academic Press
Fenner,s Veterinary Virology,1999 4th Edition.

Principles of Veterinary Immunology

Course Code & Credit Hours	VMC-505 2+1=3	**Title**	Principles of Veterinary Immunology

THEORY

Aim of the course: To understand the fundamental principles of veterinary immunology and its applications

Lecture Nos.	Topic
1	Introduction to livestock and poultry immune system

2	ontogeny and phylogeny of vertebrate immune system
3	Cells and organs of immune System
4	Types of immunity: Innate and adaptive immune system
5	Antigen and its characteristics: Characteristic of ideal antigen; Classification of antigens, Factors affecting immunogenicity, Concept of hapten and carrier
6	Antigenic determinant/ epitope and cross reactivity. B-cell epitope and T cell epitope
7	Immunoglobulins: Basic structure and function of immunoglobulins
8	Immunoglobulin diversity and immunoglobulin classes.
9	Antigen recognition by B cell and T cell:
10	B cell receptor / immunoglobulins and
11	T cell receptor
12	Receptor diversity -B cell and T cell activation
13	Major Histocompatibility Complex (General feature, structure)
14	Major Histocompatibility Complex: function, gene organization
15	MHC and immune response and Cytokines and chemokines
16	Immune response development – Phases of humoral immune response
17	Immune response development – Phases of cell mediated immune response
18	Immunoregulation with B and T cells: Antigen recognition by TCR
19	Immunoregulation with B and T cells: antigen presentation and processing
20	Immunoregulation with B and T cells: MHC restriction
21	Cell mediated immune response: General properties of effector T cells, cytotoxic T cells, NK-cells and ADCC. Role of integrin and selectin
22	Complement System: Basic concept of complement, mechanism of complement activation,
23	complement pathways and Complement deficiencies
24	Autoimmunity and autoimmune diseases and Immunological tolerance
25	Hypersensitivity: classification
26	Hypersensitivity: mechanism of induction with examples.
27	Immunodeficiency: Types with examples
28	Immune response in foetus and new born
30	Antigen antibody interaction: Antibody affinity, avidity
31	Antigen antibody interaction: cross reactivity
32	Antigen antibody interaction: precipitation and agglutination test
33	Antigen antibody interaction: radio-immunoprecipitation assay (RIPA)
34	ELISA, Western blotting
35	Immunodiagnostics and Immunotherapy
36	Monoclonal antibodies and methods for production and characterization of monoclonal antibodies

PRACTICAL

Practical No.	Practical
1	Preparation of antigens
2	Raising of antisera against soluble and insoluble antigens
3	Detection of antibody by gel diffusion
4	Detection of antibody by radial immunodiffusion
5	Detection of antibody by immunoelectrophoresis techniques
6	Haemagglutination test
7	Haemagglutination inhibition test
8	ELISA and its modifications
9	Different types of ELISA
10	Immunoblotting
11	Different Agglutination tests: Plate agglutination
12	Different Agglutination tests: Slide agglutination
13	Separation and purification of Immunoglobulin from serum
14-15	Separation of mononuclear cells from blood by density gradient centrifugation
16	Viable count of lymphocyte by dye exclusion method
17-18	Measurement of T cell response (DTH, lymphoproliferative assay).

Suggested Readings:

1. Kindt TJ, Goldsby RA & Osborne BA. 2007. *Kuby Immunology*. 6th Ed. WH Freeman.
2. Male D, Brostoff J, Roth DB & Roitts I. 2007. *Immunology*. 7th Ed. Mosby-Elsevier.
3. Tizard IR. 2004. *Veterinary Immunology: An Introduction*. 8th Ed. Saunders/Elsevier

Veterinary Mycology

Course Code & Credit Hours	VMC-506 1+1=2	**Title**	Veterinary Mycology

THEORY

Aim of the course: To learn detailed morphological, cultural features, virulence factors, antigenic and structural components, epidemiology, pathogenesis, diagnosis and control of fungal infections

Lecture Nos.	Topic
	UNIT I
1	History of mycology, Morphology of fungi

2	Structure and ultra-structure
3	Differentiation, nutrition,
4	Physiology, reproduction,
5	Spores and cultural characters
6	Classification of fungi of veterinary importance
7	Glossary of mycological terms and antifungal agents
8	Important techniques in diagnosis of fungal infections
	UNIT II
9	Aspergillosis
10	Candidiasis, Cryptococcosis and Pachydermatitis
11	Epizootic lymphangitis and Rhinosporodiosis
12	Zygomycosis and Blastomycosis
13	Sporotrichosis and Histoplasmosis
14	Coccidioidomycosis and Mycetomas,
15	Mycotic abortion and Mycotic mastitis
16	Dermatophytoses and Dermatomycosis
17	Mycotoxicosis and Emerging mycoses
18	Malassezia infections

PRACTICAL

Practical No.	Practical
1	Collection of clinical material for isolation of fungi.
2	Processing of clinical material for isolation of fungi
3	Microscopy of fungi: Lactophenol cotton blue
4	India ink preparations
5	Preparation of basal fungal media of veterinary importance.
6	Preparation of special fungal media of veterinary importance
7	Slide culture technique for fungi.
8	cellophane tape technique for fungi
9-10	Diagnosis of dermatophytes
11	Biosafety precautions in handling yeast and dimorphic fungi
12	Study of gross characters of pathogenic fungi,
13	Study of microscopic characters of pathogenic fungi
14	antifungal sensitivity testing,
15-16	Detection of mycotoxin.
17-18	Serological and molecular diagnosis in fungi.

Suggested Readings

Glen Sonder J & Karen W Post 2005. *Veterinary Microbiology: Bacterial and Fungal Agents of Animal Diseases*. Cold Spring Harbor Lab. Press.
Essentials of Veterinary Bacteriology and Mycology by Carter 6th Ed.

Vaccinology

Course Code & Credit Hours	VMC- 507 2+0 = 2	**Title**	Vaccinology

THEORY

Lecture Nos.	Topic
Aim of the course To understand different aspects of vaccines, their production, standardization and quality control of various vaccine used in animals**.**	
	UNIT I
1	Types of vaccines
2	Vaccine components, Immunogens and factors influencing choice of vaccines
3-4	New generation vaccines- subunit vaccines, peptide vaccines and recombinant vaccines
5	Recombinant vaccines
6	Reverse genetics vaccines, and
7	Marker vaccine
8	DIVA vaccines
9	Transmission blocking vaccines
	UNIT II
10	Preparation of vaccines- Identification of candidate strain, identification of epitopes
11	Preparation of vaccines- Identification of candidate strain, identification of epitopes
12	Seed and challenge strain maintenance
13	Classical methods of exaltation and attenuation of pathogens and their molecular basis
14	Classical methods of exaltation and attenuation of pathogens and their molecular basis
15	Technology of production of different types of vaccines
16	Technology of production of different types of vaccines
17	Recent advances in vaccine delivery systems and multicomponent vaccines
18	Recent advances in vaccine delivery systems and multicomponent vaccines

19	Advances in vaccines, adjuvants with their classification and mode of action
20	Advances in vaccines, adjuvants with their classification and mode of action
	UNIT-III
21	Standardization of veterinary vaccines as per National and Global standards
22	Standardization of veterinary vaccines as per National and Global standards
23	Laws and regulatory requirements concerning veterinary biologicals
24	Laws and regulatory requirements concerning veterinary biologicals
25	Indian pharmacopoeia
26	Indian pharmacopoeia
	UNIT IV
27	Vaccine failure
28	Post vaccinal reactions
29	Factors affecting response to vaccines and Quality control
30	Factors affecting response to vaccines and Quality control
31	Principles of development of vaccination schedule
32	Principles of development of vaccination schedule
33	Methods of conducting vaccine trials (lab to field use)
34	Pharmaco-vigilance
35	Scaling up methods of vaccine production
36	Scaling up methods of vaccine production

Suggested Readings:

- MM Levine, JB Kaper, R Rappuoli, MA Liu and MF Good. 2004. New Generation Vaccines. 3rd Ed. Marcel-Dekker.
- Dodds WJ & Schulz R. (Eds). 1999. *Veterinary Vaccines and Diagnostics*. Vol. 41 (*Advances in Veterinary Medicine*) 1st Ed. Academic Press.
- Levine MM, Kaper JB, Rappuoli R, Liu MA & Good MF. 2004. *New Generation Vaccines*. 3rd Ed. Marcel-Dekker.
- Pastoret PP, Blancou J, Vannier C & Verschueren C. 1997. *Veterinary Vaccinology*. Elsevier.

Techniques in Microbiology

Course Code & Credit Hours	VMC- 508 0+2 = 2	**Title**	Techniques in Microbiology

THEORY

Lecture Nos.	Topic
	UNIT I
1	Orientation to a microbiology laboratory
2	Different sterilization and disinfection techniques

3	Different sterilization and disinfection techniques
4	Laboratory biosafety and biosecurity
5	Microscopy
6	Microscopy
7	Media preparation for aerobes
8	Media preparation for anaerobes
9	Isolation, cultivation and purification of bacteria and fungi
10	Isolation, cultivation and purification of bacteria and fungi
11	Morphological and biochemical characterization
12	Morphological and biochemical characterization
13	Morphological and biochemical characterization
14-16	Antibacterial sensitivity test by Disc diffusion, broth dilution and MIC determination technique
	UNIT II
17-18	Cultivation of viruses in embryonated eggs
19-21	Cultivation of viruses in cell culture
22	VNT
	UNIT III
23-24	Different immunological techniques- Agglutination
25-26	Precipitation
27-28	HA and HI
29-30	ELISA
31	FAT (Direct)
32	FAT (Indirect)
33	RIA
34-36	Other immunological assays

Suggested Readings:

- S. Peter Borriello, Patrick R. Murray and Guido Funke. Topley and Wilson's Microbiology and Microbial Infections, Bacteriology Volumes I & II. Hodder Arnold Glen Sonder J & Karen W Post 2005. *Veterinary Microbiology: Bacterial and Fungal Agents of Animal Diseases.* Cold Spring Harbor Lab. Press.
- Prescot LM, Harley JP & Klen DA. 2005. *Microbiology*. Wm. C. Brown Publ.
- Tortora GJ, Funke BR & Case CL. 2004. *Microbiology: An Introduction*. Benjamin/Cummins Publ.
- C.L. Gyles, J. F Prescott, J.G. Songer, C.O. Thoen. Pathogenesis of Bacterial Infections in Animals. 2004 Wiley

Techniques in Molecular Microbiology

Course Code & Credit Hours	VMC- 509 1+2 = 3	Title	Techniques in Molecular Microbiology

THEORY

Lecture Nos.	Topic
Aim of the course To provide training in Molecular biology and other diagnostic techniques used in Microbiology.	
	UNIT I
1	Basic requirements for establishing molecular diagnostics Laboratory
2-3	Principles of molecular diagnostic tests
4-5	Methods of nucleic acid extraction from pathogenic microorganisms
	UNIT II
5	PCR and variants of PCR
6	PCR and variants of PCR
7	PCR and variants of PCR
8	Principles of primer designing
9	Gel electrophoresis methods
10	Blotting Techniques- Southern blotting,
11	Northern blotting
12	Western blotting and dot-blot
13	Nucleic acid sequencing methods
14	Sequence analysis-sequence editing, sequence alignment, sequence comparison and phylogentic analysis
15	Gene cloning and expression
16	Molecular diagnosis as epidemiological tool
17	Development and validation of diagnostic tests
18	Development and validation of diagnostic tests

PRACTICAL

Practical No.	Topic
	UNIT I
1	Orientation of molecular diagnosis laboratory
2-3	RNA and Diagnostic PCR lab (Handling RNA and DNA)
4	DNA and Diagnostic PCR lab
5-7	Extraction of nucleic acid from different microbes (Gram Positive bacteria, Gram Negative bacteria, DNA viruses and RNA Viruses)
8	Extraction of nucleic acid from moulds
9	Extraction of nucleic acid from yeast

10-11	DNA and RNA isolation from cell culture and blood
12-13	RNA isolation from cell culture and blood
14-15	Quality and quantity check of nucleic acid-Microtitre spectrophotometry and gel electrophoresis
	UNIT-II
16	Principles for Primer designing
17	Procedure for molecular diagnostic tests like PCR, and
18	Procedure for molecular diagnostic tests like RT-PCR
19	Procedure for molecular diagnostic tests like LAMP 3
20	Absolute and relative quantitation of DNA using Real time PCR.
21	Absolute and relative quantitation of RNA using Real time PCR.
22-23	SDS PAGE of proteins and RNA
24-25	Study of nucleic acid and proteins by blotting techniques
26-27	Restriction Enzyme Techniques (REA and RFLP)
28-29	PCR product concentration and purification for sequencing
30-31	Nucleic acid sequence analysis
32	Gene Cloning, expression and purification of expression products
33	Gene Cloning, expression and purification of expression products
34	Gene Cloning, expression and purification of expression products
35	Idea of high throughput sequencing and MALDI-TOF
36	Idea of high throughput sequencing and MALDI-TOF

Suggested readings:

- Molecular Biology Techniques,A Classroom Laboratory Manual,4th Edition - March 5, 2019 Authors: Sue Carson, Heather Miller, Melissa Srougi, D. Scott Witherow
- Principles and Techniques of Biochemistry and Molecular Biology Paperback – 14 July 2010 by Wilson/Walker (Author)
- Techniques for Molecular Biology Paperback – 2 December 2019 by D Tagu (Author), C Moussard (Author)
- 1st Edition Advances in Molecular Techniques By Rakesh S. Sengar, Amit Kumar, Reshu Chaudhary, Ashu Singh
- Molecular Biology Techniques: An Intensive Laboratory Course Paperback – Import, 17 November 1998 by Walt Ream (Author), Katharine G. Field

Molecular Immunology

Course Code & Credit Hours	VMC 510 1+1=2	**Title**	Molecular Immunology

THEORY

Lecture Nos.	**Topics**
	UNIT I

1	Molecular Structure and function of PRRs
2	Ligands of PRRs and signal transduction through Toll Like Rceceptor (TLR)
3	Inflammosome
4	Cytokines
5	Lymphocyte markers and CD nomenclature
	UNIT II
6	Molecular structure of Immunoglobulin class, isotypes, synthesis and expression of immunoglobulin
7	Immunoglobulin class, isotypes, synthesis and expression of immunoglobulin
8	Rearrangement and its organization, immunoglobulin gene diversity
9	Mechanism of recombination of B cell gene
10	Theory of antibody generation
11	Signature molecules of T cell and T reg cell,
12	T cell receptor and T cell gene diversity
	Unit III
13	MHC structure,
14	Genomic organization of the MHC gene haplotype and pathway of signal transduction
15	Concept of congenic and syngeneic and Concept of polymorphism of MHC gene
16	Role of co-stimulators in B cell and T cell activation and recruitment of adaptor proteins
17	Role of co-stimulators in T cell activation and recruitment of adaptor proteins
18	Molecular mechanisms (events) of cell cytotoxicity

PRACTICAL

Practical No.	**Topics**
	UNIT I
1	Isolation and purification of mammalian and avian immunoglobulin by precipitation technique by Caprylic acid and PEG2.
2	Isolation and purification of mammalian and avian immunoglobulin by precipitation technique by Ammonium Sulphate
3	Isolation and purification of mammalian and avian immunoglobulin by precipitation technique by Sodium Sulphate
4	Separation of immunoglobulins by size, charge and ligand affinity size exclusion chromatography (Sephadex 200), Ion exchange chromatography (DEAE), affinity chromatography (Protein-A, Sepharose)
5	Separation of immunoglobulins by size, charge by Immuno-electrophoresis Technique
6	Polyacrylamide gel electrophoresis innative and reducing conditions; fixed and gradient gel
7	Polyacrylamide gel electrophoresis innative and reducing conditions; fixed and gradient gel

8	Western blot
9	Crossed immune-electrophoresis
10	Solid Phase ELISA
11	Chemiluminscence assay
12	Cell cytotoxicity assay
13	Non radioactive methods like LDH realease assay
14	Antigen detection by Immuno PCR
15	Haplotype matching between individuals
16	Haplotype matching between individuals
17	Flow cytometry for CD4 and CD8 ratio determination and other applications
18	ELISPOT test for cytokine assay

Suggested reading:

1) Cellular and Molecular Immunology by Abul K. Abbas MBBS (Author), Andrew H. Lichtman MD PhD (Author).
2) Molecular Immunology: How Science Works Authors: Carsten Carlberg, Eunike Velleuer

Mucosal Immunology

Course Code & Credit Hours	VMC 511 1+0=1	**Title**	Mucosal Immunology

THEORY

Lecture Nos.	Topic
	UNIT I
1	Mucosal barrier- Development and physiology of mucosal defence. Mucosal inductive and effector sites
2	Cells and lymphoid tissues of mucosal immune system
3	Mucosa-associated lymphoid tissue (*MALT*) gut-associated lymphoid tissue (GALT), bronchus-associated lymphoid tissue (BALT) and nasal-associated lymphoid tissue (NALT)
4	Innate immune response at mucosal surfaces: Mucus, Antimicrobial peptides
5	Role of Pattern recognition receptors (PRRs)
6	Intestinal Dendritic cell and intestinal macrophage
7	Antigen uptake and presentation at mucosal sites and trans-epithelial transport of antigen
8	Mucosal Immunoglobulin, IgA synthesis and transport to intestinal lumen
9	Extrathymic Description and role of Paneth cell and crypto patches
10	M-cells their functions
11	M-cells functions
12	Mucosal immune effector mechanisms including secretory IgA response

13	T cell development in mucosal tissues and their phenotypes and functions
14	Importance and limitations of mucosal immunization.
15	Mucosal adjuvants and delivery systems
16	Oral tolerance mechanistic approach
17	Immunopathology at mucosal surfaces: Celiac disease, Inflammatory bowel disease, Jhone's disease
18	Assessment of mucosal immune response and potency testing

Suggested reading:

1) Mucosal Immunology,4th Edition Editors: Jiri Mestecky, Warren Strober, Michael W. Russell, Hilde Cheroutre, Bart N. Lambrecht, Brian L Kelsall Hardback
2) Mucosal Immunology by Jiri Mestecky (Editor), Michael E. Lamm (Editor), Pearay L. Ogra (Editor),

Introduction to Microbial Bioinformatics

Course Code & Credit Hours	VMC 512 1+0=1	**Title**	Introduction to Microbial Bioinformatics

THEORY

Lecture Nos.	Topic
	UNIT I
1	Introduction to Bioinformatics; History, Scope and Application
2	Bioinformatics Resources and databases
3	Introduction to NCBI, ExPASy and Ensembl Genome browser
	UNIT II
4	Sequence comparison and alignment methods
5	Principal and methods of Pairwise sequence alignment
6	Dot plot analysis
7	BLAST and FASTA programs and their variants
8	DNA and protein sequence analysis
9	Introduction to Multiple sequence alignment
10	Introduction to Phylogenetic analysis 1
11	Introduction to Phylogenetic analysis 2
12	Global multiple sequence alignment (CLUSTAL-W)
	UNIT III
13	Introduction to protein structure and databases
14	Structure based protein classification
15	Protein structure database -CASP

16	Protein structure alignment tools (VAST, DALI)
17	Protein 3-D structure visualization and modelling 1
18	Protein 3-D structure visualization and modelling 2

Suggested Readings:
Introduction to Bioinformatics - Arthur Lesk
Biological Sequence Analysis - Cambridge University Press
Biological Sequence Analysis: Probabilistic Models of Proteins and Nucleic Acids - Richard Durbin Beginning Perl for Bioinformatics - Tisdall James

PhD:

For Regular Candidates: Ph.D. Programme

Semester-wise distribution of courses

S. No.	Course No.	Title	Credits
		SEMESTER I	
1	VMC 601	Advances in Veterinary Bacteriology *	2+1=3
2	VMC 602	Advances in Veterinary Mycology	2+1=3
3	VMC 604	Microbial Toxins	2+1=3
4	VMC 611	Advances in Veterinary Immunology *	2+1=3
5	VMC 615	Current topics in Infection and Immunity	2+0=2
6	VMC 616	Veterinary Microbial Biotechnology	2+1=3
		Total compulsory credits	**4+2=6**
		SEMESTER II	
1	RPE 700	Research and Publication Ethics*	1+1=2
2	VMC 603	Bacterial Genetics	2+0=2
3	VMC 605	Bacterial Pathogenesis	2+0=2
4	VMC 606	Advances in Veterinary Virology *	2+1=3
5	VMC 607	Molecular Viral Pathogenesis	2+1=3
6	VMC 608	Structure-Function Relationship of DNA and RNA Viruses	2+0=2
7	VMC 614	Advances in Vaccinology	2+0=2
		Total compulsory credits	**3+2=5**
		SEMESTER III	
1	VMC 609	Oncogenic Viruses	2+0=2
2	VMC 610	Slow Viral Infections and Prions	1+0=1
3	VMC 612	Cytokines and Chemokines	2+0=2
4	VMC 613	Immunoregulation	1+0=1
5	VMC-690	Special Problem	0+1=1
6	VMC 691	Doctoral Seminar I *	1+0=1
7	VMC 692	Doctoral Seminar II *	1+0=1

8	VMC 699	Doctoral Research*	0+15=15
		Total compulsory credits	**2+15=17**
SEMESTER IV			
1	VMC 699	Doctoral Research*	**0+20=20**
SEMESTER V			
1	VMC 699	Doctoral Research*	**0+20=20**
SEMESTER VI			
1	VMC 699	Doctoral Research*	**0+20=20**

***Core/ compulsory Courses**

For In-service Candidates: Ph.D. Programme

Semester-wise distribution of courses

S. No.	Course No.	Title	Credits
SEMESTER I			
1	VMC 601	Advances in Veterinary Bacteriology *	2+1=3
2	VMC 602	Advances in Veterinary Mycology	2+1=3
3	VMC 604	Microbial Toxins	2+1=3
4	VMC 611	Advances in Veterinary Immunology *	2+1=3
5	VMC 615	Current topics in Infection and Immunity	2+0=2
6	VMC 616	Veterinary Microbial Biotechnology	2+1=3
		Total compulsory credits	**4+2=6**
SEMESTER II			
1	RPE 700	Research and Publication Ethics*	1+1=2
2	VMC 603	Bacterial Genetics	2+0=2
3	VMC 605	Bacterial Pathogenesis	2+0=2
4	VMC 606	Advances in Veterinary Virology *	2+1=3
5	VMC 607	Molecular Viral Pathogenesis	2+1=3
6	VMC 608	Structure Function Relationship of DNA and RNA Viruses	2+0=2
7	VMC 614	Advances in Vaccinology	2+0=2
		Total compulsory credits	**3+2=5**
SEMESTER III			
1	VMC 609	Oncogenic Viruses	2+0=2
2	VMC 610	Slow Viral Infections and Prions	1+0=1
3	VMC 612	Cytokines and Chemokines	2+0=2
4	VMC 613	Immunoregulation	1+0=1
5	VMC-690	Special Problem	0+1=1
6	VMC 691	Doctoral Seminar I *	1+0=1
7	VMC 692	Doctoral Seminar II *	1+0=1

		Total compulsory credits	**2+0=2**
SEMESTER IV			
1	VMC 699	Doctoral Research*	**0+15=15**
SEMESTER V			
1	VMC 699	Doctoral Research*	**0+15=15**
SEMESTER VI			
1	VMC 699	Doctoral Research*	**0+15=15**
SEMESTER VII			
1	VMC 699	Doctoral Research*	**0+15=15**
SEMESTER VIII			
1	VMC 699	Doctoral Research*	**0+15=15**

***Core/ compulsory Courses**

Course Outline-cum-Lecture Schedule
Ph.D. in Veterinary Microbiology

(Course distribution semester is for regular candidates)

Advances in Veterinary Bacteriology

Course Code & Credit Hours	VMC 601 2+1=3	**Title**	Advances in Veterinary Bacteriology

THEORY

Lecture Nos.	**Topic**
UNIT I	
1	Recent advances in bacterial taxonomy and phylogeny
2	Classification of bacteria
3	Bacterial phylogeny
4	Advanced studies on cytology
5	Study of microscopic details of bacteria
6	Study of ultramicroscopic details of bacteria
7	Molecular structure of bacterial cell surface peptidoglycans
	Biosynthesis and functions of bacterial cell surface peptidoglycans
8	Cell walls of Gram-positive bacteria
9	Cell walls of Gram-negative bacteria
10	Cell surface appendages: Flagella and Fimbriae - Functions and role in pathogenicity

11	Arrangement, structure and composition of Flagella
12	Structure, composition and types of Fimbriae
13	Role of bacterial cell envelope in pathogenicity- adherence, colonization
14	Role of bacterial outer membrane proteins and LPS in pathogenicity
15	Role of bacterial cell envelope in immunogenicity: evasion of host defenses
16	Evasion of host defenses (contd..)
17	Biochemical activities: Tests for Carbohydrates and
18	Sugars fermentation tests
19	Biochemical activities: Tests for Protein metabolism
20	Biochemical activities: Tests for lipid metabolism
21	Biochemical activities: Miscellaneous tests
22	Antigenic structure: Surface proteins, lipopolysaccharides
23	Antigenic structure: Peptidoglycans, outer membrane protein
24	Antigenic structure: Capsule
25	Antigenic structure: fimbriae
26	Antigenic structure: LPS, toxins
27	Bacterial secretory system
28	Role and function of bacterial secretory system
29	Bacterial excretory system
30	Role and function of bacterial excretory system
UNIT II	
31	Bacterial whole genome sequencing: Extraction of DNA
32	concentration and purity testing of DNA
33	Sequencing of bacterial whole genome: Methods
34	Sequence analysis of the whole genome using bioinformatic tools
35	Sequence analysis of the whole genome using bioinformatic tools contd.
36	Applications of bacterial whole genome sequencing

PRACTICAL

Practical No.	**Practical**
1	Isolation of bacterial LPS
2	Isolation of bacterial OMP
3	Isolation of bacterial Peptidoglycans
4	Isolation of bacterial Capsule
5	Isolation of bacterial Flagellar antigen
6	Genotyping of bacteria: DNA fingerprinting- DNA banding pattern

7	Genotyping of bacteria: DNA sequencing
8	Genotyping of bacteria: DNA hybridization
9	Phage typing of bacteria: Principle, Procedure, Results
10	Phage typing of bacteria: Principle, Procedure, Results (contd..)
11	Serotyping of bacteria: Based on somatic (O) antigens
12	Serotyping of bacteria: Based on capsular (K) antigen
13	Serotyping of bacteria: Based on flagellar (H), Pili or fimbriae antigen
14	Studies on host pathogen interactions: Using living system viz. cell cultures
15	Studies on host pathogen interactions: laboratory animals etc. (contd..)
16	Studies on host pathogen interactions: Chicken embryo
17	Studies on host pathogen interactions: At molecular level viz. gene expression, proteomics
18	Studies on host pathogen interactions: At molecular level viz. gene expression, proteomics (contd..)

Suggested Readings:

- Abbas AH. Lichtman and S. Pillai. 2017. Cellular and Molecular Immunology: Functions and Disorders of the Immune System, 7th Ed., Elsevier.
- C Hirsh, NJ MacLachlan and RL Walker. 2004. Veterinary Microbiology, 2ndEdn., Wiley Blackwell Pub.
- CM Fraser, T Read and KE Nelson. 2010. Microbial Genomes (Infectious Disease). 1st Edition, Humana Press.
- DW Mount. 2001. Bioinformatics: Sequence and genome analysis. Cold Spring Harbor, N.Y: Cold Spring Harbor Laboratory Press.
- GJ Tortora, BR Funke, CL Case, D Weber and W Bair. 2018. Microbiology: An Introduction, 13th Ed., Pearson Pub.
- L Gyles, JF Prescott, J Glenn Songer and CO Thoen. 2010. Pathogenesis of Bacterial Infections in Animals, 4thEdn., Wiley-Blackwell Pub.
- S. K. Singh. Veterinary Bacteriology. Edition: 1, 2017. Publisher: Anmol Publications Pvt. Ltd.
- Whitman, W.B., Goodfellow, M., Kämpfer, P., Busse, H.-J., Trujillo, M.E., Ludwig, W. & Suzuki, K.-i. (eds., 2012). Bergey's Manual of Systematic Bacteriology, 2nd ed., vol. 5, parts A and B, Springer-Verlag, New York, NY.
- Bergey's manual of systematics of archaea and bacteria (2015). Online ISBN: 9781118960608| DOI: 10.1002/9781118960608
- Harris Russel. 2019. Bacteriology. Publisher: Callisto Reference.

Advances in Veterinary Mycology

Course Code & Credit Hours	VMC 602 2+1=3	**Title**	Advances in Veterinary Mycology

THEORY

Lecture No.	Topic
	UNIT-I
1	Classification of fungi
2	Advanced studies on taxonomy of pathogenic fungi
3	Taxonomic genetics of fungi
4	Functional genetics of fungi
5	Molecular genetics of fungi
6	Advanced studies on genetics of pathogenic fungi
7	Structure and Physiology of fungi
8	Introduction to fungi physiology
9	Fungal nutrition and cellular biosyntheses
10	Fungal growth and reproduction
11	Fungal metabolism
12	Advanced studies on physiology of pathogenic fungi
13	Introduction to antigenic characterization of fungi
14	Fungal antigen detection
15	Immunological techniques for identification of fungal antigen
16	Antigenic variation in fungi
17	Phenotypic variation in fungi
18	Advanced studies on antigenic characterization of pathogenic fungi
	UNIT-II
19	PCR-based methods for detection of fungi
20	Sequencing independent methods
21	DNA barcoding of fungi
22	Phylogenetic studies for fungal identification
23	Advanced studies on molecular approaches for identification of fungi
24	Immunology of mycoses
25	Mechanism of innate immune recognition and evasion by pathogenic fungi
26	Serology of mycosis
27	Overview, differences, types and uses of serological tests
28	Challenges in serological diagnosis of mycoses
29	Introduction to antifungal therapy
30	Molecular mechanism of antigenic resistance
31	Advances is treatment and mycoses
32	Fungal vaccines
33	Immunotherapeutics
34	Fungal viruses
35	Future directions on virus host interactions
36	Diagnosis and treatment of fungal viral infections

PRACTICAL

Practical No.	Topic
1	Morphological studies of various fungi
2	Specimen collection
3	Microscopic examination of fungi
4	Fungal culture
5	Identification of Fungal species by biochemical studies
6	Antifungal sensitivity tests
7	Physiological studies of various fungi
8	Histological diagnosis
9	*In vivo* pathogenicity study
10	Fungal sample preparation
11	Infection studies of fungi in mice
12	Diagnosis of fungal infections
13	Molecular detection and characterization of fungi
14	PCR based diagnostics
15	Real time PCR assay
16	Sequence based diagnostics
17	Proteomic profiling
18	DNA barcoding of fungi

Suggested Readings

- Glen Sonder J & Karen W Post 2005. *Veterinary Microbiology: Bacterial and Fungal Agents of Animal Diseases*. Cold Spring Harbor Lab. Press.
- Essentials of Veterinary Bacteriology and Mycology by Carter 6th Ed.

Bacterial Genetic

Course Code & Credit Hours	VMC-603 2+0=2	**Title**	Bacterial Genetic

THEORY

	Aim: To learn the various aspects of bacterial genetics.
Lecture Nos.	**Topics**
UNIT I	
1	Comparative studies of prokaryotic and eukaryotic genome and their replication; structure, classification and replication of plasmids.. continue

2	Comparative studies of prokaryotic and eukaryotic genome and their replication; structure, classification and replication of plasmids.... continue
3	Comparative studies of prokaryotic and eukaryotic genome and their replication; structure, classification and replication of plasmids.... continue
4	Comparative studies of prokaryotic and eukaryotic genome and their replication; structure, classification and replication of plasmids... continue
5	Comparative studies of prokaryotic and eukaryotic genome and their replication; structure, classification and replication of plasmids.... continue
6	Comparative studies of prokaryotic and eukaryotic genome and their replication; structure, classification and replication of plasmids.... continue
7	Comparative studies of prokaryotic and eukaryotic genome and their replication; structure, classification and replication of plasmids.... continue
8	Comparative studies of prokaryotic and eukaryotic genome and their replication; structure, classification and replication of plasmids.... continue
9	Comparative studies of prokaryotic and eukaryotic genome and their replication; structure, classification and replication of plasmids.... continue
10	Comparative studies of prokaryotic and eukaryotic genome and their replication; structure, classification and replication of plasmids.... continue
11	Comparative studies of prokaryotic and eukaryotic genome and their replication; structure, classification and replication of plasmids.... continue
12	Comparative studies of prokaryotic and eukaryotic genome and their replication; structure, classification and replication of plasmids.
	UNIT II
10	Bacterial variations: Phenotypic and genotypic variations,.
11	Mutations and mutagenesis,
12	Types of bacterial mutants,
13	Detection of mutants and gene mapping.…continued
14	Detection of mutants and gene mapping
15	Mechanism of gene transfer…continued
16	Mechanism of gene transfer:
17	Transduction, Transformation and conjugation.…continued
18	Transduction, Transformation and conjugation.…continued
19	Transduction, Transformation and conjugation.
20	Types and mechanism of recombination…continued

21	Types and mechanism of recombination…continued
22	Types and mechanism of recombination.
23	Reciprocal, Non-reciprocal and illegitimate recombination's…continue
24	Reciprocal, Non-reciprocal and illegitimate recombination's
	UNIT III
25	Mobile genetic elements.…continued
26	Mobile genetic elements…continued
27	Mobile genetic elements…continued
28	Mobile genetic elements…continued
29	Molecular mechanism of antibiotic resistance ….continued
30	Molecular mechanism of antibiotic resistance…continued
31	Molecular mechanism of antibiotic resistance…continued
32	Molecular mechanism of antibiotic resistance.
33	Regulation of gene expression.…continued
34	Regulation of gene expression.…continued
35	Regulation of gene expression.…continued
36	Regulation of gene expression.

Suggested reading:

Bacterial Genetics and Genomics, 1st edition by Lori Snyder (Author)
Textbook of Microbial Genetics By Chaudhari

Microbial Toxins

Course Code & Credit Hours	VMC-604 2+1=3	**Title**	Microbial Toxins

THEORY

	Aim: To learn about the structure, Mechanism of action, Methods of detection of various bacterial and fungal toxins
Lecture Nos.	**Topic**
	UNIT I

1	Classification of bacterial toxin on the basis of their structure and functions.
2	Classification of bacterial toxin on the basis of their structure and functions.
3	Classification of fungal toxin on the basis of their structure and functions.
4	The role of microbial toxins in the pathogenesis of diseases … continue
5	The role of microbial toxins in the pathogenesis of diseases. … continue
6	The role of microbial toxins in the pathogenesis of diseases.
7	Biochemical and biological characteristics of toxins.
8	Biochemical and biological characteristics of toxins.
9	Toxin producing Grams-positive and Grams negative bacteria … continued
10	Toxin producing Grams-positive and Grams negative bacteria….. continued
11	Toxin producing Grams-positive and Grams negative bacteria.
12	Properties and clinical conditions produced by different bacterial toxins.
13	Properties and clinical conditions produced by different bacterial toxins.
14	Properties and clinical conditions produced by different fungal toxins.
15	Properties and clinical conditions produced by different fungal toxins.
16	Analytical methods for detection of bacterial toxins ..continue
17	Analytical methods for detection of bacterial toxins.
18	Analytical methods for detection of fungal toxins.
19	Biological assays…. continued
20	Biological assays.
21	Immunological assays.. continued
22	Immunological assays
23	Nucleic acid-based methods … continued
24	Nucleic acid-based methods.
	UNIT II
25-30	Application of microbial studies studies of toxins.
31-36	Application immunobiological studies of toxins.

PRACTICAL

Practical No.	Practical
1	Detection and identification of Mycotoxigenic fungi and mycotoxins …continued
2	Detection and identification of Mycotoxigenic fungi and mycotoxins.
3	Detection and identification of Mycotoxigenic fungi and mycotoxins.
4	Method of detection of bacterial endotoxin,
5	Method of detection of bacterial endotoxin,
6	Production of toxins in suitable media,
7	Production of toxins in suitable media,
8	Production of toxins in suitable media,
9	Purification and characterization of toxins,
10	Purification and characterization of toxins,
11	Purification and characterization of toxins,
12	Biological characterization in animal.
13	Biological characterization in animal.
14	Biological characterization in tissue culture.
15	Biological characterization in tissue culture.
16	Toxin neutralization test.
17	Toxin neutralization test.
18	Toxin neutralization test.

Suggested Readings:

1) Microbial toxins:– Rajeeva Gaur (Author), Soni Tiwari (Author), Ranjan ingh (Author)

2) Microbial Toxins: Current Research and Future Trends: Publisher: Caister Academic Press Edited by: Thomas Proft

Bacterial Pathogenesis

Course Code &	VMC 605	Title	Bacterial Pathogenesis

Credit Hours	2+0=2		

THEORY

	Aim: To learn the molecular mechanisms of bacterial pathogenesis.
Lecture Nos.	**Topic**
	UNIT I
1	Molecular structure of bacterial virulence factors…continue
2	Molecular structure of bacterial virulence factors…continue
3	Molecular structure bacterial virulence factors.
4	Production of bacterial virulence factors…continue
5	Production of bacterial virulence factors…continue
6	Production of bacterial virulence factors.
7	Mode of action of bacterial virulence factors…continue
8	Mode of action of bacterial virulence factors…continue
9	Mode of action of bacterial virulence factors.
9-16	Bacterial biofilms and advance studies on pathogenesis of bacterial diseases of various systems.
	UNIT II
17-24	Host-pathogen interaction,
25-36	Animal models for bacterial pathogens.

Suggested Readings:

1) Bacterial Pathogeneis: Methods and Protocols by Editors: Pontus Nordenfelt, Mattias Collin

2) Salyers Abigail A.Bacterial Pathogenesis: A Molecular Approach, Second Edition 2001 Washington, DC American Society for Microbiology

Advances in Veterinary Virology

Course Code & Credit Hours	VMC 606 2+1=3	**Title**	Advances in Veterinary Virology

THEORY

Lecture Nos.	Topic
	UNIT I
1	Biology of RNA virus replication
2	Biology of RNA virus replication
3	Biology of DNA virus replication
4	Biology of DNA virus replication
5	An introduction to bacteriophages replication
6	An introduction to bacteriophages replication
7	An introduction to phage replication
8	An introduction to phage replication
	UNIT II
9	Current concepts in animal virus research with respect to viral structure and architecture,
10	Current concepts in animal virus research with respect to viral virulence,
11	Current concepts in animal virus research with respect to viral pathogenesis,
12	Current concepts in animal virus research with respect to persistence
13	Current concepts in animal virus research with respect to oncogenesis
14	Viruses as bio-terror agents
15	Viruses for pest management (Bio-control).
	UNIT III
16	Scope of Antiviral drugs
17	Use and limitations of Antiviral drugs
18	Use and limitations of Antiviral drugs
19	Existing antiviral drugs and their mechanism of action
20	Existing antiviral drugs and their mechanism of action
21	Latest trends in antiviral drug development
	UNIT IV
22	Preparation of plasmid backbone
23	Preparation of plasmid backbone
24	preparation of viral genes for cloning
25	preparation of viral genes for cloning
26	cloning in viral genome backbone
27	Confirmation of cloned genes
28	Development of positive marker
29	Development of positive marker
30	Development of negative markers

31	Development of negative markers
32	DIVA vaccine
33	DIVA vaccine
34	Different types of viral vectors (vaccinia, adenoviral, retroviral vectors)
35	Different types of viral vectors (vaccinia, adenoviral, retroviral vectors)
36	Different types of viral vectors (vaccinia, adenoviral, retroviral vectors)

PRACTICAL

Practical No.	Practical
	Characterization of viral proteins and genome. Problem oriented practical assignments aimed at development of bioreagents and relevant diagnostic tests.
1	Characterization of viral proteins and genome
2	Characterization of viral proteins and genome
3	Characterization of viral proteins and genome
4	Characterization of viral proteins and genome
5	Characterization of viral proteins and genome
6	Characterization of viral proteins and genome
7	Characterization of viral proteins and genome
8	Characterization of viral proteins and genome
9	Characterization of viral proteins and genome
10	Problem oriented practical assignments aimed at development of bioreagents and relevant diagnostic tests
11	Problem oriented practical assignments aimed at development of bioreagents and relevant diagnostic tests
12	Problem oriented practical assignments aimed at development of bioreagents and relevant diagnostic tests
13	Problem oriented practical assignments aimed at development of bioreagents and relevant diagnostic tests
14	Problem oriented practical assignments aimed at development of bioreagents and relevant diagnostic tests
15	Problem oriented practical assignments aimed at development of bioreagents and relevant diagnostic tests
16	Problem oriented practical assignments aimed at development of bioreagents and relevant diagnostic tests
17	Problem oriented practical assignments aimed at development of bioreagents and relevant diagnostic tests
18	Problem oriented practical assignments aimed at development of bioreagents and relevant diagnostic tests

Suggested Readings:

1 SJ Flint, V Racaniello, G Rall and A Skalka. 2015. Principles of Virology, 4th Edition (2 volume set). ASM press
2 S Jameel and L Villarreal. 2000. Advances in Animal Virology. Science Pub.
3.TA Brown. 2016. Gene Cloning and DNA Analysis. 7th Edition., Wiley Blackwell
4 WJ Dodds and R Schulz. 1999. Veterinary Vaccines and Diagnostics. Vol. 41 (Advances in Veterinary Medicine) 1st Ed. Academic Press.
5. MM Levine, JB Kaper, R Rappuoli, MA Liu and MF Good. 2004. New Generation Vaccines. 3rd Ed. Marcel-Dekker.

Molecular Viral Pathogenesis

Course Code & Credit Hours	VMC 607 2+1=3	**Title**	Molecular Viral Pathogenesis

THEORY

Lecture Nos.	**Topics**
	UNIT I
1	Study of virus host interactions: host specificity, tissue tropism and mechanism of virus spread in the body
2	Study of virus host interactions: host specificity, tissue tropism and mechanism of virus spread in the body
3	Study of virus host interactions: host specificity, tissue tropism and mechanism of virus spread in the body
	UNIT II
4	Host immune responses to viral infections
5	Host immune responses to viral infections
6	Viral strategies to evade host immune responses
7	Viral strategies to evade host immune responses
8	Viral interference and interferons
9	Viral interference and interferons
	UNIT III
11	Pathogenesis of viral diseases of various systems
12	Pathogenesis of viral diseases of various systems
13	Pathogenesis of viral diseases of various systems

14	Animal models for studying viral pathogenesis
15	Animal models for studying viral pathogenesis
16	Animal models for studying viral pathogenesis
17	Molecular and genetic determinants of viral virulence
18	Molecular and genetic determinants of viral virulence
19	Molecular and genetic determinants of viral virulence
20	Mechanisms of viral virulence
21	Mechanisms of viral virulence
22	Mechanisms of viral virulence
	UNIT IV
23	Molecular and genetic determinants of viral persistence
24	Molecular and genetic determinants of viral persistence
25	Molecular and genetic determinants of viral persistence
26	Molecular and genetic determinants of viral persistence
27	Viral oncogenesis
28	Viral oncogenesis
29	Viral oncogenesis
30	Viral oncogenesis
31	Viral immunosuppression and immunopathology
32	Viral immunosuppression and immunopathology
33	Viral immunosuppression and immunopathology
34	Viral immunosuppression and immunopathology
35	Viral immunosuppression and immunopathology
36	Viral immunosuppression and immunopathology

PRACTICAL

Practical No.	Practical
1	Pathotyping of animal viruses using Newcastle disease virus as model
2	Pathotyping of animal viruses using Newcastle disease virus as model
3	Pathotyping of animal viruses using Newcastle disease virus as model
4	Pathotyping of animal viruses using Newcastle disease virus as model
5	Pathotyping of animal viruses using Newcastle disease virus as model

6	Determination of immunosuppressive potential of animal viruses using infectious bursal disease virus/ Marek's disease virus/ chicken anaemia virus
7	Determination of immunosuppressive potential of animal viruses using infectious bursal disease virus/ Marek's disease virus/ chicken anaemia virus
8	Determination of immunosuppressive potential of animal viruses using infectious bursal disease virus/ Marek's disease virus/ chicken anaemia virus
9	Determination of immunosuppressive potential of animal viruses using infectious bursal disease virus/ Marek's disease virus/ chicken anaemia virus
10	Determination of immunosuppressive potential of animal viruses using infectious bursal disease virus/ Marek's disease virus/ chicken anaemia virus
11	Determination of immunosuppressive potential of animal viruses using infectious bursal disease virus/ Marek's disease virus/ chicken anaemia virus
12	Characterization of molecular determinants of viral virulence using variants, recombinants and reassortants
13	Characterization of molecular determinants of viral virulence using variants, recombinants and reassortants
14	Characterization of molecular determinants of viral virulence using variants, recombinants and reassortants
15	Characterization of molecular determinants of viral virulence using variants, recombinants and reassortants
16	Characterization of molecular determinants of viral virulence using variants, recombinants and reassortants
17	Characterization of molecular determinants of viral virulence using variants, recombinants and reassortants
18	Characterization of molecular determinants of viral virulence using variants, recombinants and reassortants

Suggested Readings:

1. JB Carter and VA Saunders. 2013. Virology: Principles and Applications, 2nd Ed., John Wiley and Sons Pub
2. NJ Maclachlan and EJ Dubovi. 2016. Fenner's Veterinary Virology. 5thEdn., Academic Press.
3. SJ Flint, V Racaniello, G Rall and A Skalka. 2015. Principles of Virology, 4th Edition (2 volume set). ASM press
4. S Jameel and L Villarreal. 2000. Advances in Animal Virology. Science Pub

Structure Function Relationship of DNA and RNA Viruses

Course Code & Credit Hours	VMC 608 2+0=2	**Title**	Structure Function Relationship of DNA and RNA Viruses

THEORY

Lecture Nos.	**Topic**
	UNIT I
1	Methods of studying virus structure and architecture
2	Methods of studying virus structure and architecture
3	Methods of studying virus structure and architecture
4	Methods of amplification of viral nucleic acids
5	Methods of amplification of viral nucleic acids
6	Molecular characterization of viral protein and nucleic acids
7	Molecular characterization of viral protein and nucleic acids
8	Molecular characterization of viral protein and nucleic acids
9	Nucleotide sequencing and its analysis by software programmes
10	Nucleotide sequencing and its analysis by software programmes
11	Nucleotide sequencing and its analysis by software programmes
12	Nucleotide sequencing and its analysis by software programmes
13	Nucleotide sequencing and its analysis by software programmes
14	Nucleotide sequencing and its analysis by software programmes
15	Nucleotide sequencing and its analysis by software programmes
16	Nucleotide sequencing and its analysis by software programmes
	UNIT II
17	Detailed study of virus replication in various groups of animal viruses
18	Detailed study of virus replication in various groups of animal viruses
19	Detailed study of virus replication in various groups of animal viruses
20	Detailed study of virus replication in various groups of animal viruses
21	Detailed study of virus replication in various groups of animal viruses
22	Detailed study of virus replication in various groups of animal viruses
	UNIT III
23	Understanding the relationship between structure and function of animal DNA and RNA viruses
24	Understanding the relationship between structure and function of animal DNA and RNA viruses
25	Understanding the relationship between structure and function of animal DNA and RNA viruses

26	Understanding the relationship between structure and function of animal DNA and RNA viruses
27	Understanding the relationship between structure and function of animal DNA and RNA viruses
28	Understanding the relationship between structure and function of animal DNA and RNA viruses
29	Development of modern vaccines and antivirals using the relationship between structure and function of animal DNA and RNA viruses
30	Development of modern vaccines and antivirals using the relationship between structure and function of animal DNA and RNA viruses
31	Development of modern vaccines and antivirals using the relationship between structure and function of animal DNA and RNA viruses
32	Development of modern vaccines and antivirals using the relationship between structure and function of animal DNA and RNA viruses
33	Development of modern vaccines and antivirals using the relationship between structure and function of animal DNA and RNA viruses
34	Development of modern vaccines and antivirals using the relationship between structure and function of animal DNA and RNA viruses
35	Development of modern vaccines and antivirals using the relationship between structure and function of animal DNA and RNA viruses
36	Development of modern vaccines and antivirals using the relationship between structure and function of animal DNA and RNA viruses

Suggested Readings:

1.D Balasubramanian, CFA Bryce, K Jayaraman, J Green and K Dharmalingam. 2004. Concepts in Biotechnology, Revised edition, Universities Press Pub.

2. DW Mount. 2001. Bioinformatics: Sequence and genome analysis. Cold Spring Harbor, N.Y: Cold Spring Harbor Laboratory Press.

3.FA Murphy, EPJ Gibbs, MK Holzmek and MJ Studdert. 1999. Veterinary Virology. 3rd Ed. Academic Press.

Oncogenic Viruses

Course Code & Credit Hours	VMC- 609 2+0 = 2	**Title**	Oncogenic Viruses
THEORY			
Lecture Nos.	**Topic**		
	UNIT I		
1	History, discovery and Taxonomy of viruses-tumor complications		
2	Taxonomy and classification of oncoviruses: Structural organization		
3	Morphology and Genetic organization of Oncoviruses		

4	General features of cell transformation and characterization of transformed cells
5	Oncogenic RNA viruses
6	Oncogenic DNA viruses
7	RNA-Retroviruses – Alpha, Delta
8	RNA-Retroviruses –Delta, Gama
9	DNA-Adeno, Hepadna, Herpes
10	DNA- Papilloma, Polioma, Pox
11	Oncolytic viruses
12	Herpes simplex
13	Oncorine
14	Mechanism of action of Oncorine and similar viruses
15	Oncolytic behaviour of wild types
16	Viral oncogenes
17	Cellular oncogenes
18	Mechanism of viral oncogenes
	UNIT II
19	Mechanism of viral oncogenes
20	Similarities between viral and cellular oncogenes
21	Retro viruses carrying cellular genes
22	Retro viruses carrying cellular genes
23	Retro viruses activating proto-oncogenes I
24	Retro viruses activating proto-oncogenes II
25	Other RNA oncoviruses
26	DNA viruses targeting tumour suppressor proteins I
27	DNA viruses targeting tumour suppressor proteins II
28	Multistep carcinogenesis – co-operativity of oncogenes
29	Multistep carcinogenesis – co-operativity of oncogenes
30	Other mechanisms of oncogenesis
31	Diagnosis of viral oncogenesis
32	Molecular Diagnosis of DNA oncoviruses
33	Molecular Diagnosis of RNA oncoviruses
34	Molecular Diagnosis of Oncolytic RNA viruses
35	Serodiagnosis of Oncoviruses
36	Other methods of diagnosis of oncoviruses

Suggested Readings:

1.FA Murphy, EPJ Gibbs, MK Holzmek and MJ Studdert. 1999. Veterinary Virology. 3rd Ed. Academic Press.

2.NJ Maclachlan and EJ Dubovi. 2016. Fenner's Veterinary Virology. 5thEdn., Academic Press.

3.SJ Flint, V Racaniello, G Rall and A Skalka. 2015. Principles of Virology, 4th Edition (2 volume set). ASM press

4.S Jameel and L Villarreal. 2000. Advances in Animal Virology. Science Pub

5. Moulay Ennaji, 2021, Oncogenic Viruses-Fundamentals of Oncoviruses,1st Edition Paperback ISBN: 9780128241523

Slow Viral Infections and Prions

Course Code & Credit Hours	**VMC- 610** **1+0 = 1**	**Title**	Slow Viral Infections and Prions

THEORY

Lecture Nos.	**Topic**
	UNIT I
1	Slow viruses introduction and historical development
2	Epidemiology of slow viral infections
3	Pathogenesis of slow viral infections
4	Diagnosis of slow viral infections
5	Control of slow viral infections
	UNIT II
6	Properties and replication of slow viruses
7	Epidemiology of prions
8	Scrapie I
9	Scrapie II
10	Bovine spongiform encephalopathy
11	Diagnosis and control of BSE
12	Chronic wasting disease of dear
13	Diagnosis and control of CWD
14	Transmissible mink encephalopathy
15	Diagnosis and control of TME

16	Recent trends in prion research
17	Advance techniques of diagnosis of slow viral infections I
18	Advance techniques of diagnosis of slow viral infections

Suggested Readings:

1.FA Murphy, EPJ Gibbs, MK Holzmek and MJ Studdert. 1999. Veterinary Virology. 3rd Ed. Academic Press.
2.NJ Maclachlan and EJ Dubovi. 2016. Fenner's Veterinary Virology. 5thEdn., Academic Press.
3.SJ Flint, V Racaniello, G Rall and A Skalka. 2015. Principles of Virology, 4th Edition (2 volume set). ASM press
4.S Jameel and L Villarreal. 2000. Advances in Animal Virology. Science Pub
5. David H. Adams, Thomas Matthew Bell (1976) Slow Viruses, Addison-Wesley Publishing Company, Advanced Book Program.

Advances in Veterinary Immunology

Course Code & Credit Hours	VMC- 611 2+1=3	**Title**	Advances in Veterinary Immunology

THEORY

Lecture Nos.	**Topic**
	UNIT I
1	Significance of Hemopoietic Stem Cell l
2	Origin of myeloid cells
3	Lymphoid cells (T and B cells)
4	Lymphoid cells (NK cells and NKT cells)
5	Apoptosis and its role in homeostatic mechanism
6	Ontogeny of the lymphoid tissue in mammals and birds
7	Cell adhesion molecules
8	Recirculation and trafficking of lymphocytes
9	Cell homing receptor
10	Antigen presenting cells and their functions at cellular level
11	Cytokines, chemokines and cytokine receptors
12	Role of cytokines in regulation of immune response
13	Role of cytokines in regulation of immune response
14	Early development of T and B cells and its differentiation and maturation in primary lymphoid organ
	UNIT II
15	B cell development
16	T cell development

17	Lineage commitment
18	Memory generation
19	Organization of lymphocyte receptors gene
20	Expression of lymphocyte receptors gene
21	Multiagenic organization of immunoglobulin gene
22	Thymic selection of T cell repertoire
23	Concept of extra-thymic origin of T cells
24	Effector and memory T and B cells
25	Mechanism of recombination of immunoglobulin genes and T cell receptor genes
26	Mechanism of recombination of immunoglobulin genes and T cell receptor genes
27	Clonal expansion
28	Role of T cell help in B cell response
29	Affinity maturation of B cells and class switching and T cell activation
30	MHC class-I and II structure and gene arrangement, polymorphism,
31	Antigen processing and presentation mechanism
32	Effector mechanisms of CTL
33	NK cells and NK T cell activation
34	Regulation of immune response
35	Cont.. Regulation of immune response
36	Role of T reg-cells, immunological tolerance and graft rejection
	PRACTICAL
Practical No.	**Practical**
1	Purification of immunoglobulin classes and subclasses
2	Fragmentation of antibody by enzyme digestion to F (ab)2 and Fc fragments,
3	Affinity chromatography techniques I
4	Affinity chromatography techniques II
5	Separation of protein by SDS PAGE under reducing condition I
6	Separation of protein by SDS PAGE under reducing condition II
7	Western blot experiment to detect the immunogenic protein I
8	Western blot experiment to detect the immunogenic protein II
9	Enzyme Linked Immunosorbent Spot Assay I
10	Enzyme Linked Immunosorbent Spot Assay I
11	Cytotoxic T cell assay I
12	Cytotoxic T cell assay II
13	Morphological and functional assays of blood monocytes I
14	Morphological and functional assays of blood monocytes II
15	Fluorescence-activated Cell Sorting I

16	Fluorescence-activated Cell Sorting I
17	Magnetic Activated Cell Sorting I
18	Magnetic Activated Cell Sorting II

Suggested Readings:

1. Kindt TJ, Goldsby RA & Osborne BA. 2007. *Kuby Immunology*. 6th Ed. WH Freeman.
2. Male D, Brostoff J, Roth DB & Roitts I. 2007. *Immunology*. 7th Ed. Mosby Elsevier.
3. Tizard IR. 2004. *Veterinary Immunology: An Introduction*. 8th Ed. Saunders/Elsevier
4. Cellular and Molecular Immunology, 10th Edition Authors : Abul K. Abbas & Andrew H. Lichtman & Shiv Pillai Date of Publication: 07/2021

Cytokines and Chemokines

Course code & Credits	VMC- 612 2+0 = 2	**Title**	Cytokines and Chemokines

THEORY

Lecture Nos.	**Topic**
	UNIT I
1-2	Properties of cytokines
3-5	General structure and function of classification of cytokines family's, cytokine secretion by Th1 and Th2 subsets
6-7	Cytokines cross regulation
8-10	Cytokine receptors:general structure of cytokine receptors, immunoglobulin superfamily receptors, class 1 and class 2 cytokine receptor families
11-12	TNF receptor families and cytokine antagonists
	UNIT II
13-14	Cytokine related diseases
14-15	Therapeutic uses of cytokines and their receptors
16-18	Chemokines: subgroups of chemokines and their structures and functions, chemokine receptor families
	UNIT III
19-20	Types of immunomodulators and their mechanism of action
21-22	Adjuvants: classification, mode of action, adjuvants combination and safety
23-24	Cytokine as adjuvant, PLG and microparticle as adjuvant, TLR agonist as adjuvant
25-26	Antigen delivery system and mode of action

27-29	Immunostimulants: bacterial product and synthetic compound, complex carbohydrates, immune enhancing drugs, vitamins and cytokines
	UNIT IV
30-32	Immunosuppression, Neuroendocrine control of immunoregulation,
33	Immunosuppressive agents and drugs, corticosteroids, cyclosporin's, cyclophosphamide and other agents, like irradiation and the mode of action
34	Immunosuppressive agents and drugs, corticosteroids, cyclosporin's, cyclophosphamide and other agents, like irradiation and the mode of action
35-36	Immunosuppressive agents and drugs, corticosteroids, cyclosporin's, cyclophosphamide and other agents, like irradiation and the mode of action

Suggested readings:

- Cellular and Molecular Immunology –Abbas
- KuBy Immunology By Jenni Punt. Sharon Stranford

Immunoregulation

Course Code & Credit Hours	VMC 613 1+0=1	**Title**	Immunoregulation

Aim: To study recent advances in immunoregulation mechanisms

THEORY

Lecture Nos.	**Topic**
	Unit I
1	Molecular mediators of immune response: Lymphokines
2	Molecular mediators of immune response: monokines
3	Idiotypic networks
4	Idiotypic networks contd.
5	Epitope specific regulation
6	Epitope specific regulation contd.
7	Helper T (Th) and Cytotoxic T (Tc)
8	regulatory T (Treg) cells
9	MHC in immunoregulation
10	MHC in immunoregulation contd.
11	Immune response genes
12	Immune response genes contd
13	Antigen specific suppressor molecules produced by T cells

14	Antigen specific suppressor molecules produced by T cells
15	Immunosuppressive agents
16	Immune-stimulation
17	Immunoregulatory pathways
18	Immunoregulatory pathways contd

Suggested Readings:

Kindt TJ, Goldsby RA and Osbrne BA. 2007. *Kuby Immunology*. WH Freeman.

Male D, Brostoff J, Roth DB and Roitt I. 2006. *Immunology*. Elsevier.

Spinger TA. 1985. *Hybridoma Technology in Biosciences and Medicine*. Plenum Press.

Veterinary Immunology by Ian Tizard 2016, 10th Edition Elsevier publication

Cellular and Molecular Immunology, 10th Edition Authors : Abul K. Abbas & Andrew H. Lichtman & Shiv Pillai Date of Publication: 07/2021

Advances in Vaccinology

Course Code & Credit Hours	VMC 614 2+0=2	**Title**	Advances in Vaccinology

THEORY

Lecture Nos.	Topic
	UNIT I
1	Different phases in vaccine development - Exploratory Stage, Pre-clinical stage
2	Different phases in vaccine development - Clinical development
3	Different phases in vaccine development – Regulatory review and approval
4	Different phases in vaccine development – Manufacturing
5	Different phases in vaccine development – Quality control
6	Direct correlates of protection
7	Indirect correlates of protection
8	Antigen identification and characterization - microarrays
8	Antigen identification and characterization - in vivo expression technology
9	Antigen identification and characterization - in vivo expression technology
10	Antigen identification and characterization - signature-tagged mutagenesis
11	Antigen identification and characterization - signature-tagged mutagenesis
12	Antigen identification and characterization - phage display technology
	UNIT II

13	Immuno-informatics applied to epitope mapping - Introduction
14	Immuno-informatics applied to epitope mapping - Bioinformatics tools to predic potential T cell binding-epitopes
15	Immuno-informatics applied to epitope mapping - Bioinformatics tools to predic potential T cell binding-epitopes
16	Immuno-informatics applied to epitope mapping – Bioinformatics tools to predic potential T cell binding-epitopes
17	Immuno-informatics applied to epitope mapping - Bioinformatics tools for predicting potential B cell binding-epitopes
18	Immuno-informatics applied to epitope mapping - Bioinformatics tools for predicting potential B cell binding-epitopes
19	Immuno-informatics applied to epitope mapping – Bioinformatics tools for predicting potential B cell binding-epitopes
20	T cell epitopes
21	Identification of pathogenic epitopes - 1
22	Identification of pathogenic epitopes - 2
23	Identification of pathogenic epitopes – 3
24	Introduction to modern vaccines
25	Nucleic acids vaccines
26	Marker vaccines
27	Mucosal vaccines
28	Bacterial ghost vaccines
29	Virus-like particles
30	Futuristic vaccines: anti-allergic
31	Futuristic vaccines: anti-allergic
32	Futuristic vaccines: anti-autoimmune diseases
33	Futuristic vaccines: de-addiction vaccines
34	Futuristic vaccines: transplant survival vaccines
36	Futuristic vaccines: prolonging vaccines

Suggested Readings:

1) Vaccinology and Methods in Vaccine Research (Developments in Immunology) by Nigeria) Oli, Angus Nnamdi , Agulu Campus, Agulu, Anambra State (Editor)
2) Vaccinology: An Essential Guide Editor(s): Gregg N. Milligan PhD,, Alan D.T. Barrett PhD, First published:5 December 2014 Print ISBN:9780470656167 |Online ISBN:9781118638033 |DOI:10.1002/9781118638033.
3) Recent literature, research articles and review.

Current Topics in Infection and Immunity

Course Code & Credit Hours	VMC 615 2+0=2	Title	Current Topics in Infection and Immunity

THEORY

Lecture Nos.	Topic
	UNIT I
1	Introduction and historical developments
2	Host-pathogen relationship (Gram positive bacteria)
3	Host-pathogen relationship (Gram positive bacteria)
4	Host-pathogen relationship (Gram Negative bacteria)
5	Host-pathogen relationship (Gram Negative bacteria)
6	Host-pathogen relationship (Fungi)
7	Host-pathogen relationship (Viruses)
8	Host-pathogen relationship (Viruses)
9	Host-pathogen relationship (Viruses)
10	Host-pathogen relationship (Rickettsia, Chlamydia, Ehrlichia etc)
11	Host-pathogen relationship (Rickettsia, Chlamydia, Ehrlichia etc)
	UNIT II
12	Effector mechanisms of specific and non-specific immunity to different groups of microbes (Gram positive bacteria)
13	Effector mechanisms of specific and non-specific immunity to different groups of microbes (Gram positive bacteria)
14	Effector mechanisms of specific and non-specific immunity to different groups of microbes (Gram Negative bacteria)
15	Effector mechanisms of specific and non-specific immunity to different groups of microbes (Gram Negative bacteria)
16	Effector mechanisms of specific and non-specific immunity to different groups of microbes (Fungi)
17	Effector mechanisms of specific and non-specific immunity to different groups of microbes (Fungi)
18	Effector mechanisms of specific and non-specific immunity to different groups of microbes (Viruses)
19	Effector mechanisms of specific and non-specific immunity to different groups of microbes (Viruses)
20	Effector mechanisms of specific and non-specific immunity to different groups of microbes (Rickettsia, Chlamydia, Ehrlichia etc)
21	Effector mechanisms of specific and non-specific immunity to different groups of microbes (Rickettsia, Chlamydia, Ehrlichia etc)
	UNIT III
22	Immunobiology of major viral diseases of animals

23	Immunobiology of major viral diseases of animals
24	Immunobiology of major bacterial diseases of animals
25	Immunobiology of major bacterial diseases of animals
26	Immunobiology of major bacterial diseases of animals
27	Immunobiology of major fungal diseases of animals
28	Types of vaccines for infectious diseases (Bacteria)
29	Types of vaccines for infectious diseases (Viruses)
30	Types of vaccines for infectious diseases (Fungi)
31	Types of vaccines for infectious diseases (Protozoa)
32	Types of vaccines for infectious diseases (Modern)
33-36	Current trends in vaccine development

Suggested Readings:

- Recent literature, research articles and reviews
- Autophagy Infection and the Immune Response 2014 By Jackson and Swanson. Publisher Wiley

Veterinary Microbial Biotechnology

Course code & Credits	VMC 616 2+1=3	**Title**	Veterinary Microbial Biotechnology

THEORY

Lecture Nos.	**Topic**
	UNIT I
1	History of microbial biotechnology
2	Microbes in nature
3	Microbes as infectious agents of human and animals
4	Host-microbe relationships
5	Microbial metabolism and growth characteristics
6	Microbial genetics
	UNIT II
7-8	Introduction to molecular biology of microorganisms
9-10	DNA replication, RNA transcription, reverse transcription, protein translation and regulatory mechanisms
11	Bacterial extrachromosomal DNA elements
	UNIT III
12-13	Genetic engineering: restriction enzymes, DNA ligases, DNA polymerases, RNases and DNases and other enzymes

14-15	DNA sequencing
16-17	Plasmids and phage-derived vectors, bacterial hosts for cloning and expression of transgenes
18	Genomic libraries and sequencing
19-20	Blotting of DNA and RNA
21	Blotting of proteins
22	Polymerase chain reaction
23	An introduction to Microarrays
24	An introduction to Metagenomics
	UNIT-IV
25-26	Expression of antigens and antibody fragments useful as diagnostic reagents and vaccines
27-28	PCR and blotting techniques in infectious disease diagnosis
29	Nucleic acid vaccines
30	Vectored viral and bacterial vaccines
31	Vectored bacterial vaccines
32-33	Construction of defined mutants and marker vaccines using genetic manipulation techniques
34-36	Manipulation of microbial processes for production of industrially useful substances

PRACTICALS

Practical Nos.	**Practical**
1	Extraction of nucleic acids from bacteria
2	Extraction of nucleic acids from DNA viruses
3	Extraction of nucleic acids from RNA viruses
4	Restriction endonuclease digestion of DNA and resolution in agarose gel electrophoresis
5	PCR amplification of DNA
6	RT-PCR of RNA
7	Real time PCR
8	Insertion of DNA fragments into plasmid/ phagemid/ phage vectors
9	Insertion of DNA fragments into plasmid/ phagemid/ phage vectors
10	Construction of competent E. coli host cells
11	Construction of competent E. coli host cells
12	Transformation and transfection of competent E. coli cells
13	Screening of transformants and isolation of clones

14	Sequence analysis of clones/ PCR amplicons
15	Expression of genes of bacterial/ viral antigens
16	Expression of genes of bacterial/ viral antigens
17	Use of PCR for infectious disease diagnosis
18	Use of PCR for infectious disease diagnosis

Suggested reading:

- Recent literature, research articles and reviews
- The Condensed Protocols: From Molecular Cloning: A Laboratory Manual Paperback – 1 January 2006 by Russell Sambrook (Author)