M.Sc. Virology Syllabus (Credit System)

University of Pune (2008-09)
### M. Sc. Virology
Credits offered

<table>
<thead>
<tr>
<th></th>
<th>Theory</th>
<th>Practical</th>
<th>Total</th>
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<tbody>
<tr>
<td>Semester I</td>
<td>10</td>
<td>15</td>
<td>25</td>
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<tr>
<td>Semester II</td>
<td>11</td>
<td>15</td>
<td>26</td>
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<tr>
<td>Semester III</td>
<td>10</td>
<td>14</td>
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<tr>
<td>Semester IV</td>
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<tr>
<td><strong>Total</strong></td>
<td>42</td>
<td>59</td>
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Total credits offered during 1st year (Sem 1 + Sem 2) = 51  
Total credits offered during 2nd year (Sem 3 + Sem 4) = 50

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**Keys for numbering courses**

- **1XX**: Basic courses
- **2XX**: Advanced courses
- **3XX**: Special courses
- **X1X, X3X, X5X, X7X**: Theory course
- **X2X, X4X, X6X, X8X**: Practical courses
- **X0X**: Remedial courses (Not planned)
M. Sc. Virology: List of courses offered

<table>
<thead>
<tr>
<th>Present No</th>
<th>New No</th>
<th>Title of the Course</th>
<th>Credits</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td><strong>SEMESTER I</strong></td>
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</tr>
<tr>
<td>VR111 (T)</td>
<td>VR 111</td>
<td>Basic Virology</td>
<td>1</td>
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<tr>
<td>VR 112 (T)</td>
<td>VR 112</td>
<td>Tissue Culture &amp; Cell Biology</td>
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<tr>
<td>VR 113 (T)</td>
<td>VR 113</td>
<td>Basic Immunology</td>
<td>2</td>
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<tr>
<td>VR 114 (T)</td>
<td>VR 114</td>
<td>Basic Epidemiology &amp; Biostatics</td>
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<tr>
<td>VR 115 (T)</td>
<td>VR 115</td>
<td>Vector Biology</td>
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<td>VR 116 (T)</td>
<td>VR 116</td>
<td>Virological Methods</td>
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<tr>
<td>VR 126 (P)</td>
<td>VR 131</td>
<td>Analytical Methods</td>
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<td>VR 121 (P)</td>
<td>VR 132</td>
<td>Tissue Culture Techniques</td>
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<td>VR 127 (P)</td>
<td>VR 133</td>
<td>Virus/Antigen Detection</td>
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<td>VR 124 (P)</td>
<td>VR 134</td>
<td>Statistical Methods</td>
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<td>VR 125 (P)</td>
<td>VR 135</td>
<td>Entomological Methods</td>
<td>3</td>
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<tr>
<td>VR 122 (P)</td>
<td>VR 136</td>
<td>Propagation of Viruses</td>
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<td><strong>Total Credits for Sem I: Theory (10) + Practical (15) = 25</strong></td>
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<td><strong>SEMESTER II</strong></td>
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<tr>
<td>Vr 132 (T)</td>
<td>VR 211</td>
<td>Gene Regulation &amp; Recombinant DNA Technology</td>
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<tr>
<td>VR 231 (T)</td>
<td>VR 212</td>
<td>Virus-Cell Interaction</td>
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<td>VR 136 (T)</td>
<td>VR 213</td>
<td>Virus Replication</td>
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<tr>
<td>VR 233 (T)</td>
<td>VR 214</td>
<td>Advanced Immunology</td>
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<tr>
<td>VR 235 (T)</td>
<td>VR 215</td>
<td>Applied Entomology</td>
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<td>Applied Epidemiology</td>
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<td>Bioinformatics</td>
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<td>VR 137 (T)</td>
<td>VR 218</td>
<td>Antiviral &amp; Vaccines</td>
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<td>VR 142 (P)</td>
<td>VR 231</td>
<td>Molecular Techniques</td>
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<tr>
<td>VR 246 (P)</td>
<td>VR 232</td>
<td>Biochemical &amp; Biophysical Methods</td>
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<td>VR 247 (P)</td>
<td>VR 233</td>
<td>Serological Methods</td>
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<td>VR 143 (P)</td>
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<td>Immunological Techniques</td>
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<td>Medical Entomology</td>
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<td>VR 244 (P)</td>
<td>VR 236</td>
<td>Epidemiological Data Management &amp; Analysis</td>
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<td>VR 148 (P)</td>
<td>VR 237</td>
<td>Bioinformatics</td>
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<td>VR 151 (T)</td>
<td>VR 311</td>
<td>Viral Enteric Diseases &amp; Cancers</td>
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<tr>
<td>VR 158 (T)</td>
<td>VR 312</td>
<td>Viral Hepatitis</td>
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<td>VR 152 (T)</td>
<td>VR 313</td>
<td>Viral Respiratory Diseases</td>
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<td>VR 153 (T)</td>
<td>VR 314</td>
<td>Viral Exanthematous Diseases</td>
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<td>VR 154 (T)</td>
<td>VR 315</td>
<td>Viral Haemorrhagic Fevers</td>
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<td>VR 157 (T)</td>
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<td>Viral Encephalitis</td>
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<td>VR 155 (T)</td>
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<td>HIV/AIDS</td>
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<td>VR 156 (T)</td>
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<td>Veterinary &amp; Agricultural Viruses</td>
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<td>VR 163 (P)</td>
<td>VR 334</td>
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<td>VR 164 (P)</td>
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<td>VR 167 (P)</td>
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<td><strong>Total Credits for Sem III : Theory (10) + Practical (15) = 25</strong></td>
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<tr>
<td>VR 311 (T)</td>
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<td>Special Topics</td>
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<tr>
<td>VR 322 (T+P)</td>
<td>VR 431</td>
<td>Research Project</td>
<td>24</td>
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|          |          |                  |         |
|          |          | **Total Credits for Sem IV =25** |         |

One credit = 15 hr of interaction of students with facilitator

**N.B. For assessment of each course, 50% will be for Semester-end examination and 50% for internal assessment. Internal assessment will be continuous throughout the semester, and the marks should be submitted to the Examination section before the commencement of Semester-end examination.**
Semester I: Theory courses

VR111 (T) Basic Virology 1 Credit
Module 1: Introduction 5 hrs.
History and principles of virology, virus taxonomy, introduction to replication strategies.
Module 2: Virus structures, animal and plant viruses 5 hrs.
Virus structure and morphology, viruses of veterinary importance and plant viruses.
Module 3: Infrastructure 5 hrs.
Principles of biosafety, containment facilities, maintenance and handling of laboratory animals and requirements of virological laboratory.

Recommended Books:

VR112 (T) Tissue Culture and Cell Biology 2 Credits
Module 1: Cell structure 5 hrs.
Structure and function of cellular organelles, cytoskeleton, cell division, biomembranes, cell adhesion and junctions.
Module 2: Macromolecules: 5 hrs.
Structure and function of DNA, RNA, proteins, carbohydrates and lipids.
Module 3: Molecular biology 6 hrs.
Replication of DNA, transcription and posttranscriptional modifications, protein biosynthesis, posttranslational modifications.
Module 4: Cell signaling 2 hrs.
Signal transduction pathways.
Module 5: Tissue culture methods: 7 hrs.
In vitro cultures—primary, diploid and established cell lines, organ culture, fish and invertebrate cultures, cell types in culture. Cell environment—nutritional requirements, substrates. Cell characterization—karyotyping, growth rates, isoenzymes, and differentiation—normal and transformed cells. Large scale production—suspension cultures, microcarriers, hollow fiber reactors, etc.

Recommended Books:
VR113 (T) Basic Immunology 2 Credits

Module 1: Introduction to immunology 5 hrs.
   Introduction and history of immunology, primary and secondary organs of immune system, cells of the immune system.

Module 2: Innate immunity 4 hrs.
   Innate immune response, complement system.

Module 3: Immunoglobulins 4 hrs.
   Antibody structure and function, Immunoglobulin class.

Module 4: Antigen recognition 7 hrs.
   Antibody diversity, major histocompatibility complex, ontology, positive and negative selection.

Module 5: Acquired immune response 6 hrs.
   Antigen presenting cells, T cell stimulation, hypersensitivity.

Module 6: Antiviral immune response & hybridoma technology 4 hrs.
   Immune responses in various viral infections, generation of monoclonal antibodies—principles and applications.

Recommended Books:

VR114 (T) Basic Epidemiology and Biostatistics 2 Credits

Module 1: Introduction 5 hrs.
   Historical aspects and evolution of epidemiology, definitions and concepts in Epidemiology.

Module 2: Approaches in epidemiology 8 hrs.
   Descriptive and analytical epidemiology, disease burden, natural history of diseases and measures of risk and death.

Module 3: Study design and sampling 4 hrs.
   Sample size estimation and introduction to study design in epidemiological investigations.

Module 4: Fundamentals of biostatistics 4 hrs.
   Introduction, types of data, tabular and graphical presentation of data.

Module 5: Measures of location, dispersion and correlation 4 hrs.

Module 6: Probability and statistical inference 5 hrs.
   Concept and probability distribution. Normal distribution—density curves, applications and statistical tables. Concept of significance tests, parametric and nonparametric tests, standard error and confidence intervals.

Recommended Books:
VR115 (T) Vector Biology 1 Credit

Module 1: Insect morphology, collection and preservation 5 hrs.
Introduction to general entomology, insect morphology and classification. Insects and other arthropods of medical importance and their structures and functions. Methods for collecting these insects and arthropods, their preservation/maintenance and transportation.

Module 2: Biology and ecology of mosquitoes 5 hrs.
Biology and life history of Aedes, Culex and Anopheles, their behavior and ecology with special reference to dengue, chikungunya, Japanese encephalitis and West Nile

Module 3: Biology and ecology of other blood sucking insects, Ticks and mites 5 hrs.

Recommended Books:

VR116 (T) Virological methods 2 Credits

Module 1: Cultivation and purification of viruses 5 hrs.
In vivo, in vitro and in ovo systems for virus growth, estimation of yields, methods for purification of viruses with special emphasis on ultracentrifugation methods.

Module 2: Diagnostic methods 10 hrs.
Immunodiagnosis, haemagglutination and haemagglutination inhibition tests, Complement fixation, neutralization, Western blot, RIPA, flowcytometry and immunohistochemistry.

Module 3a) Nucleic acid based diagnosis 7 hrs.
Nucleic acid hybridization, polymerase chain reaction, microarray and nucleotide sequencing.

Module 3b) Microscopic techniques: 3 hrs.
Fluorescence, confocal and electron microscopic techniques principles and applications.

Module 4: Analytical techniques 5 hrs.
Electrophoresis, chromatography, membrane filtration, NMR, Xray crystallography.

Recommended Books:
Semester I: Practical Courses

VR121 (P): Tissue culture techniques  3 Credits
1. Glassware decontamination, washing, sterilization, packing and sterile handling  5 hrs.
2. Media and reagents preparation, sterility checks  8 hrs.
3. Maintenance of cell cultures  16 hrs.
4. Preparation of primary cell culture (CEC)  16 hrs.

VR122 (P): Propagation of viruses  3 Credits
1. Estimation of virus yields plaque assay & TCID$_{50}$  18 hrs.
2. Preparation virus stocks and determination of mouse LD$_{50}$  18 hrs.
3. Routes of inoculations in embryonated eggs  9 hrs.

VR124 (P): Statistical Methods  1 Credit
1. Graphical presentation of data  3 hrs.
3. Correlation and regression analysis  3 hrs.
4. Significance tests  3 hrs.
5. Statistical packages  3 hrs.

VR125 (P): Entomological methods  3 Credits
1. Mosquito collection & taxonomy  8 hrs.
2. Taxonomy of ticks and sandflies  8 hrs.
3. Processing of arthropods  8 hrs.
4. Mosquito inoculation & immunofluorescence  8 hrs.
5. Insecticide testing  8 hrs.
6. Collection of rodents  5 hrs.

VR126 (P): Analytical methods  2 Credits
1. Protein estimation (Lowry)  5 hrs.
2. DNA estimation (colorimetric and spectrophotometric)  8 hrs.
3. Gel filtration chromatography  5 hrs.
4. Polyacrylamide gel electrophoresis  8 hrs.
5. Confocal microscopy  4 hrs.

VR127 (P): Virus / antigen detection  3 Credits
1. ELISA  8 hrs.
2. Immunofluorescence assay  8 hrs.
3. Hemagglutination  8 hrs.
4. Agar gel diffusion  5 hrs.
5. Polymerase chain reaction  8 hrs.
Semester II: Theory courses

VR132 (T) Gene Regulation & Recombinant DNA based technology  2 Credits
Module 1: Prokaryotic gene expression  5 hrs.
Polymerasepromoter interactions, control of transcription initiation and termination.
Module 2: Eukaryotic gene expression  5 hrs.
Chromosomes, chromatin structure, regulatory elements, splicing and RNA processing.
Module 3: Cloning vectors  5 hrs.
Plasmids, cosmids, lambda phage, M13 phage, BAC and YAC
Module 4: Expression vectors  10 hrs.
Module 5: Novel strategie  5 hrs.
Phage display libraries, reverse genetics, viral replicons (SFV and HCV).

Recommended Books:

VR136 (T) Virus Replication  1 Credit
Module 1: RNA viruses:  5 hrs.
General strategies, replication of plus stranded RNA virus (polio), negative strand RNA viruses (VSV and influenza).
Module 2: Other RNA viruses  5 hrs.
Replication of double stranded RNA virus (rota), ambisense RNA (LCM) and retroviruses (HIV and HTLV).
Module 3: DNA viruses  3 hrs.
Replication of double stranded DNA viruses (SV40, pox), ssDNA virus (AAV) Module 4: Miscellaneous. 2 hrs. Prion proteins, replication of plant virus (Poty).

Recommended Books:

VR137 (T) Antivirals and Viral Vaccines  2 Credits
Module 1: Viral Vaccines  10 hrs.
Conventional vaccines killed and attenuated, modern vaccines—recombinant proteins, subunits, DNA vaccines, peptides, immunomodulators (cytokines), vaccine delivery and adjuvants, large scale manufacturing—QA/QC issues.
Module 2: Antivirals  10 hrs.
Interferons, designing and screening for antivirals, mechanisms of action, antiviral libraries, antiretrovirals—mechanism of action and drug resistance.
Module 3: Modern approaches of virus control  5 hrs.
Antisense RNA, siRNA, ribozymes, in silico approaches for drug
designing.

Module 4: Assignments, group discussions and presentations  
5 hrs.

**Recommended Books:**
3. Chimeric Virus like Particles as Vacc ines. Wolfram H. Gerlich (Editor), Detlev H. Krueger (Editor), Rainer Ulrich (Editor). Latest edition / Pub. Date: November 1996 Publisher: Karger, S. Inc.

**VR138 (T) Bioinformatics  1 Credit**
Module 1: Introduction and biological data bases  
4 hrs.
Nucleic acid, proteins, genomes—structure data bases, search engines, sequence data forms and submission tools, scoring matrices for sequence alignments, algorithms—pairwise sequence alignments, database similarity searches—BLAST, FASTA.

Module 2: Methods for sequence analysis  
6 hrs.
Multiple sequence alignment, phylogenetic analysis and tree building methods, motif searches, epitope prediction, data mining tools and applications, promoter and gene prediction, comparative analysis.

Module 3: Structure based approaches  
5 hrs.
Protein secondary structure prediction, threading approaches, homology based methods for protein tertiary structure prediction, visualization tools, structure evaluation and validation, antigenantibody interactions.

**Recommended Books:**
1. Introduction to BioinformaticsLesk, A.
2. Introduction to BioinformaticsAttwood.
3. Instant notes in BioinformaticsWesthead, Parish & Twyman.

**VR231 (T) Viruscell Interaction  1 Credit**
Module 1: Cellular receptors and virus entry  
5 hrs.

Module 2: Virus morphogenesis  
3 hrs.
Replication sites and their characterization, IRES, replicomes, transport of viral proteins.

Module 3: Mechanism of host cell damage  
3 hrs.
Host cell 'shut off', apoptosis, necrosis, stress response, alteration of signaling pathways, cellular basis of transformation, types of cenotaphic effects, ultrastructural cytopathology.

Module 4: Cellular gene expression  
4 hrs.
Cellular injury associated markers, mechanism of viral persistence and latency—in vivo and in vitro models (JE, measles, LCM and HIV).

**Recommended Books:**

VR233 (T) Advanced Immunology
Module 1 Antigen presentation
- Secondary signaling, costimulation, Cell signaling in immune response. DC activation, B cells as APC, experimental models in APC.

Module 2: Molecular immunology
- Peptide epitopes T cell B cell antigenic properties, prediction of T and B cell epitopes, Chimeric peptides, polytope vaccines Major Histocompatibility Complex-1, Polymorphism.

Module 3: Effectors mechanisms:

Module 4: Immunological diseases
- Autoimmunity mechanisms, altered antigens, Systemic Lupus erythematosus, Graves diseases, Rheumatoid arthritis, Myasthenia Gravis, Multiple sclerosis, animal models of autoimmunity Transplantation immunology, GvH, Immunodeficiency: phagocytic, humoral, CMI, combined HLA association with disease.

Recommended books

VR234 (T) Applied epidemiology
Module 1: Public health surveillance
- Types and methods of public health and infectious disease surveillance, establishing surveillance system.

Module 2: Analytical epidemiology
- Case control and cohort studies.

Module 3: Outbreak investigations
- Needs and steps to be taken for outbreak investigations, collaboration with State and national health authorities.

Recommended Books:

VR235 Applied Entomology
Module 1: Vector virus relationship
- Virus dissemination & mechanism of virus transmission in vectors, natural cycle, maintenance of viruses in nature, basis of vector competence, mechanical transmission, virus dissemination, susceptibility intrinsic and extrinsic factors. Xenodiagnosis methods and application.

Module 2: Epizootiology of vector borne viral diseases
- Formation of natural foci of diseases, spatial structure and geographic variations.

Module 3: Vector Control
5 hrs.
Various control strategies and environmental management. Control in urban settings. Control at aquatic stages, adult population, personal protection, insecticide resistance mechanism and control dynamics.

Module 4: Molecular Entomology
5 hrs.

Recommended Books:
## Semester II: Practical Courses

### VR142 (P) Molecular techniques
- Growth & Preparation of competent cells: 12 hrs.
- Plasmid transformation: 12 hrs.
- Purification of plasmid: 12 hrs.
- Restriction endonuclease digestion: 8 hrs.
- DNA and RTPCR: 16 hrs.

### VR143 (P) Immunological techniques
- Lymphocyte separation: 8 hrs.
- Separation of lymphocyte subpopulation: 10 hrs.
- Mitogen stimulation: 8 hrs.
- Immunoelectrophoresis: 4 hrs.
- Flowcytometry: 8 hrs.
- ELISPOT: 8 hrs.

### VR148 (P) Practical Bioinformatics
- Biological data banks: 3 hrs.
- Pairwise sequence alignment: 3 hrs.
- Phylogeny & tree building: 3 hrs.
- Motif data bases, Epitope prediction: 3 hrs.
- Molecular modeling & visualization: 3 hrs.

### VR244 (P) Epidemiological data management and analysis
- MS Excel 2000: 4 hrs.
- MS Access 2000: 4 hrs.
- Statistical softwares: 7 hrs.

### VR245 (P) Medical entomology
- Mosquito inoculation and IFA: 8 hrs.
- Bird, Rodents, Bat trapping: 4 hrs.
- Dissection of mosquitoes: 4 hrs.
- Native PAGE and isoenzyme analysis: 4 hrs.
- Insecticide (larval & adult) bioassays: 6 hrs.

### VR246 (P) Biochemical/ Biophysical methods
- Protein A Affinity chromatography: 8 hrs.
- Protein estimation: 4 hrs.
- Polyacrylamide gel electrophoresis: 8 hrs.
- Western Blot: 10 hrs.
- Ultrafiltration: 8 hrs.
- Ultracentrifugation: 8 hrs.

### VR247 (P) Serological methods
- Hemagglutination inhibition test: 12 hrs.
- IgM capture ELISA: 12 hrs.
- Complement Fixation test: 9 hrs.
- Plaque reduction neutralization test: 12 hrs.

### VR245 (P) Medical entomology
- Mosquito inoculation and IFA: 6 hrs.
- Dissection of mosquitoes: 2 hrs.
- Insecticide (larval & adult) bioassays: 6 hrs.
- Native PAGE and isoenzyme analysis: 4 hrs.
- Biochemical Assay for insecticide resistance analysis: 6 hrs.
- Mosquito DNA extraction and RAPD profile: 6 hrs.
Semester III: Theory courses

VR 151 (T) A) Enteric Viral Diseases B) Cancers Linked to Viruses  1 credit

Module1: Perspectives of Viral Diarrhoea:  8 hrs.
  Clinical course, disease burden, risk factors, epidemiology, prevention, and
  treatment. Rotavirus diversity, emerging strains, immunopathogenesis and
  vaccines under development. Other viruses associated with diarrhoea and
  gastroenteritis: Adenoviruses, astroviruses, Norwalk and Sapporolike viruses and
  Enteroviruses Other enteroviral diseases.

Module2: Viral Cancers  7 hrs.
  Role of papilloma, HIV, Epstein Barr Virus, HTLV and herpes in pathogenesis of
  cancers, diagnosis, prevention.

Recommended books:
1  Fields Virology, 4th Ed., Vol 2 Ed by David M Knipe, and Peter M Howley Chapters: 24, 28,
    34, 54, 55, 67 and 68.
4  Human Enterovirus Infections, Harley A. Rotbart (Editor), American Society Microbiology,
5  Viral Gastroenteritis, Edited by U. Desselberger, J. Gray. Elsevier Perspectives In Medical
6  Human Papilloma Viruses. Edited by D.J. McCance. Elsevier Perspectives In Medical
7  Viruses and Liver Cancer. Edited by E. Tabor. Elsevier Perspectives In Medical Virology.
8  Viruses, Cell Transformation, and Cancer. Edited by J.A. Grand. Elsevier Perspectives In

VR 152(T) Respiratory Diseases of viral etiology  1 credit

Module 1: Origin and evolution of viral respiratory diseases  5 hrs.
  History, clinical features, epidemiology, of influenza, RSV and other respiratory diseases.
Module 2: Biology of respiratory viruses.  3 hrs.
  Biology and pathogensis of SARS, Metapneumovirus, human rhino virus and Corona virus
  etc.
Module 3: Diagnostics  3 hrs.
  Differential diagnosis of different respiratory diseases.
Module 4: Vaccines  4 hrs.
  Vaccines against different viral respiratory diseases.

Recommended books:
1  Viral Infections of Respiratory Tract by Raphael Dolin and Peter Wright. Mercel Dekker.
3  Influenza. Edited by C.W. Potter. Elsevier Perspectives In Medical Virology. Series

VR 153 (T) Exanthematous Diseases of viral aetiology  1 credit

Module1 : Measles and SSPE  5 hrs.
  Clinical features, disease burden, case definition and associated risk factor, strategies for
  prevention and treatment, biology and immunopathogenesis.
Module 2: Rubella, CRS, mumps and Poxviruses  7 hrs.
  Clinical features, disease burden of Rubella, CRS and mumps,case definition and risk
of Parvovirus B –19.
Module 3: Pox diseases 3 hrs.
Common features of viral pox diseases and case definitions. Paraspecific immunity due to pox vaccination, eradication and control programs.

Recomended books:

1. Krugman’s Infectious Diseases of children By Saul Krugman.
2. Immunization Safety Review: Vaccines and Autism Immunization Safety Review Committee (Editor) The National Academies Press, USA.

VR 154 (T) Viral Haemorrhagic Fevers 1 credit

Module1: Clinical course of viral infections 3 hrs.
Common clinical features of Viral Haemorrhagic Fevers, History and Disease burden, Risk factors and geographical distribution of viruses associated with haemorrhagic fevers and their impact on global health. Clinical samples required, choice of laboratory diagnostic tests and their interpretation for differential diagnosis.

Module2: Dengue and DHF 6 hrs.
Virus replication strategy, Pathogenesis, Prevention and treatment of Dengue Role of humoral and cell mediated immunity and viral factors in development of DHF, differential diagnosis of DF and DHF on the basis of clinical symptoms.

Module 3: Haemorrhagic manifeststions caused by other viruses 6 hrs.
Virus replication strategy, Pathogenesis, Prevention and treatment of Yellow Fever, KFD, Chikungunya, Rift Valley Fever, Hanta, Marburg and Ebola, and Rickettsial fevers Development of killed KFD vaccine.

Recommended books:

1. CRC Handbook of Viral and Rickettsial Hemorrhagic Feverby James H. S. Gear.

VR 155 (T) HIV/ AIDS 1 credit

Module:1 Natural History of AIDS 5 hrs.

Module:2 Biology of HIV and its detection 5 hrs.
Structure and replication of HIV, immunopathogenesis of infection, laboratory diagnosis of HIV infection. HIV isolation, characterization and viral estimation.

Module:3 Preventive and therapeutic approaches 2 hrs.
Trials pertaining to prevention and therapy, Antiviral therapy and drug resistance HIV vaccines.

Module 4: origin of HIV, HIV 2, SIV 3 hrs.

Recommended books:

VR 156(T) Viral Diseases of Veterinary and Agricultural Importance 1 credit

Viral diseases of veterinary importance will cover History, Disease burden, Clinical presentation and diagnosis, Epidemiology and risk factors, virus replication strategy, Pathogenesis, zoonotic importance and Prevention and treatment of species of agricultural importance.

Module 1: Farm animals 6 hrs.
- Cattle diseases: Foot and Mouth Disease, Bovine Ephemeral fever, Rinderpest, Bovine Spongiform encephalopathy
- Sheep and goat diseases: Bluetongue, Nairobi sheep disease/Ganjam, Peste des Pests ruminants, Rift Valley Fever
- Pig diseases: Swine influenza, Japanese Encephalitis, Hog cholera/ swine fever
- Horse diseases: Equine influenza, Equine infectious anemia and equine encephalitis
- Dog diseases: Rabies, Infectious canine hepatitis, Canine distemper

Module 2: Poultry and other animals 5 hrs.
- Poultry diseases: Newcastle disease, Marek’s disease, Avian influenza
- Viral diseases of laboratory animals
- Viral diseases of honeybees, silkworm and fishes

Module 3: Plant viral diseases 4 hrs.
- Viral diseases of agricultural crops
- Viral diseases of horticultural crops
- Viral diseases of forest plants
- Viral insecticides

Recommended books:
2. Veterinary Medicine by Blood and Henderson.

VR 157 (T) Viral Encephalitis 2 Credits

Module 1 Overview: 7 hrs.
- Viral Encephalitis, encephalopathy and meningitis clinical symptoms and causative agents, treatment modalities, Transmission, spread of the outbreak in relation to causative agent
- Laboratory diagnosis of viral encephalitic agents, basic principles, preferred methods and problems.

Module 2 JE, WN CHP 8 hrs.
- Japanese encephalitis and West Nile viral infections, endemic areas, disease burden, seasonality, role of non human hosts, genotypes vaccines
- Chandipura encephalitis, endemic areas, disease burden, seasonality, role of non human hosts, genotypes, other rhabdoviral neurotropic agents.

Module 3 Other viruses 8 hrs.
- Encephalitis/ encephalopathy caused by measles virus, Entroviral encephalitis and meningitis, Causative agents, spread of the disease, seasonality, differential diagnosis, Mumps encephalitis, Encephalitis caused by alpha viruses
- Encephalitis caused by Nipah and Hendra virus, Herpes virus encephalitis, diagnosis in sporadic cases, association with immunosuppression, reactivation vs primary infections, treatment.

Module 4 Pathogenesis 7 hrs.
- Routes and modalities of infections of the nervous tissue, blood brain barrier, factors affecting the neurovirulence, Animal models and vaccine potency testing.

Recommended books:
1. Viral Encephalitis in Humans. John Booss (Editor), Margaret M. Esin, Margaret Esiri (Editor).
VR158 (T) Viral Hepatitis 2 credits

Module 1: Clinical presentation and epidemiology of viral hepatitis.  7 hrs.
Physiology of Jaundice, clinical features and differential diagnosis, presentations of hepatitis caused by different hepatitis viruses.
Module 2: Structure & genomic organization 7 hrs.
Structure & genomic organization, replication, genotypes, serotypes of HAV, HBV, HCV & HEV. Mutations in hepatitis viruses.
Module 3: Diagnostics 6 hrs.
Serological and molecular diagnosis of different hepatitis viruses.
Module 4: Immunopathogenisis & animal models 4 hrs.
Immunopathogenisis of different hepatitis viruses. Animal models and their uses.
Module 5: Prevention & therapeutic approaches 6 hrs.
Historical aspects, types of hepatitis vaccines, vaccines presently used & vaccines of the future. Vaccination as preventive measure in public health. Therapeutic possibilities of the present and future.

Recommended books:

3. Hepatitis Viruses (Japan medical research fourm).
5. Viral Infection of Humans (S. Svans & A Kaslow).
6. Viral Hepatitis Molecular Biology Diagnosis and Control, By Isa Mushahwar. Elsevier Perspectives
**Semester III: Practical Courses**

**VR161 (P) Enteric viruses**  
1. Sample collection and documentation of case reporting form  
2. Sample processing and ELISA  
3. RNA PAGE  
4. Neutralization Test  
5. MAAb based serotyping of rotavirus  
6. RT-PCR  

**VR162 (P) Respiratory Diseases of Viral Etiology**  
1. Sample collection  
2. Sample processing for virus isolation and IFA  
3. IFA  
4. Virus isolation  
5. HA test  
6. HI test  

**VR163 (P) Viruses associated with exanthematous diseases**  
1. Rubella (IgG, IgM) diagnosis  
2. Measles (IgG, IgM) diagnosis  
3. Measles PCR  

**VR164 (P) Viruses associated with haemorrhagic fevers**  
1. MACELISA, Multiplex RTPCR for serotyping, RNA extraction by Trizol method, Reverse transcription  
2. PCR, agarose gel electrophoresis interpretation  
3. Haemaglutination inhibition assay  

**VR165 (P) Laboratory of HIV and AIDS**  
1. HIV Diagnosis  
2. HIV subtyping  
3. CD4, CD8 counts  

**VR167 (P) Viruses associated with encephalitis**  
1. Flavivirus neutralization tests for differential diagnosis  
2. RT PCR of JE and WN viruses  
3. Mouse inoculation and observation of sickness  
4. Diagnosis of Chandipura virus infections  
5. Antigen detection systems  
6. Antigen capture ELISA and Immunofluorescence  

**VR168 (P) Viruses associated with Hepatitis**  
1. Serum ALT, Urine Bile salt, Bile pigments  
2. HBV DNA PCR (DNAzol / Column method)  
3. HAV RNA PCR (TRIzol / Column method)  
4. Real Time PCR quantitation for HBV DNA  
5. Pre-Core mutant analysis
Semester IV List of courses

VR311(T) Special topics

List of special topics
1. How to write a research proposal
2. How to write a scientific paper
3. Role of laboratories in virological studies
4. Ethics in Biomedical Research
5. Ethical and regulatory issue in animal experiment
6. Ethical issues in biotechnology
7. Basics of Intellectual Property Rights
8. Indian patenting system
9. Patenting in biotechnology
10. Trade Related Intellectual Property Rights (TRIPS) and public health
11. Other topics on regulatory issues

VR322 (T+P) Dissertation

25 credits