



# **GONDWANA UNIVERSITY**

## **GADCHIROLI**

**SYLLABI AND COURSE OF PG  
STUDIES IN**

# **MICROBIOLOGY**

**SEMESTER III and IV  
UNDER NEP 2020 PROGRAMME**

**SESSION 2024-ONWARDS**

**NEP 2020**  
**SEMESTER PATTERN**  
**M.Sc. Microbiology (PG) Program**  
**Faculty of Science and Technology**  
(Affiliated Colleges)  
(W.e.f. Academic Year 2023-24)

**Scheme of teaching and examination under semester pattern for M.Sc. Program in Microbiology.**

SEM	Core Course	Elective	Research Project
SEM III	<b>Major 1- STPG03MCB001</b> (4 Credits) (4Hours/Week)	<b>STPG03MCB004 to STPG03MCB008</b>  <b>Elective Course</b> - Student shall select any one course. (4 Credits) (4Hours/Week)  <b>Practical - 50 Marks</b> <b>2 Credit</b> Based on any one elective paper	<b>STPG03MCB009</b>  <b>Research Project</b> (4 Credits) (4Hours/Week)
	<b>Major 2 - STPG03MCB002</b> (4 Credits) (4Hours/Week)		
	<b>Major 3 - STPG03MCB003</b> (4 Credits) (4 Hours/Week)		
	<b>Practical - I (50 Marks) (2 credits)</b> Based on Major Course only (3-8 Hour/Week)		

**Total 22 Credits**

SEM	Core Course	Elective	Research Project
SEM IV	<b>Major 1- STPG04MCB001</b> (4 Credits) (4Hours/Week)	<b>STPG04MCB003 to STPG04MCB007</b>  <b>Elective Course</b> - Student shall select any one course. (4 Credits) (4Hours/Week)	<b>STPG04MCB008</b>  <b>Research Project</b> (6 Credits) (4Hours/Week)
	<b>Major 2 - STPG04MCB002</b> (4 Credits) (4Hours/Week)		
	<b>Practical - I (50 Marks) - 2 Credit</b> Based on Major Paper - I <b>Practical - II (50 Marks) - 2 Credit</b> Based on Major Paper - II (3-8 Hour/Week)		
<b>Total 22 Credits</b>			

### Paper wise Marking Distribution Scheme

SEM – III						
Major (Mandatory)	Credit	Elective	Credit	Research Project	Credit	Total Credit
<b>STPG03MCB001</b> <b>Genetics and Molecular Biology</b>  UA = 80M CA = 20M	(4x3) 12	<b>STPG04MCB004</b> <b>Food Microbiology and Food Safety</b>  UA = 40M CA = 10M	02	<b>STPG03MCB009</b> <b>Research Project</b>  Project = 60M Internal = 40M	4	22
<b>STPG03MCB002</b> <b>Recombinant DNA Technology</b>  UA = 80M CA = 20M		<b>STPG04MCB005</b> <b>BIOCHEMISTRY</b>  UA = 40M CA = 10M				
<b>STPG03MCB003</b> <b>Bioprocess Technology</b>  UA = 80M CA = 20M		<b>STPG04MCB006</b> <b>Cell Biology</b>  UA = 40M CA = 10M				
<b>Practicals</b> Practical Based on <b>Major</b> – 50M  Practical Based on <b>Elective</b> – 50M		<b>STPG04MCB007</b> <b>Instrumentation and Biotechniques</b>  UA = 40M CA = 10M				
	02	<b>STPG04MCB008</b> <b>Microbial Metabolism</b>  UA = 40M CA = 10M  <b>Note: Student can select any one elective paper</b>				

### Paper wise Marking Distribution Scheme

SEM – IV						
Major (Mandatory)	Credit	Elective	Credit	Research Project	Credit	Total Credit
<b>STPG04MCB001</b> <b>Medical Microbiology and Parasitology</b> UA = 80M CA = 20M	(4x2) 08	<b>STPG04MCB003</b> <b>Virology</b> UA = 80M CA = 20M	4	<b>STPG04MCB008</b> <b>Research Project</b>  Project = 90 Internal = 60	6	<b>22</b>
<b>STPG04MCB002</b> <b>Immunology</b> UA = 80M CA = 20M		<b>STPG04MCB004</b> <b>Biostatistics and Bioinformatics</b> UA = 80M CA = 20M				
<b>Practicals</b>  <b>Pract - I</b> (Based on Major - I) <b>50 Mark</b>		<b>STPG04MCB005</b> <b>Microbes in Environment</b> UA = 80M CA = 20M				
<b>Pract - II (2 Credit)</b> (Based on Major - II) <b>50 Mark</b>		<b>STPG04MCB006</b> <b>Microbial Diagnosis in Health Clinics</b> UA = 80M CA = 20M				
	02	<b>STPG04MCB007</b> <b>Management of Human Microbial Diseases</b> UA = 80M CA = 20M				
	02	<b>Note: Student can select any one elective paper</b>				



**Gondwana University, Gadchiroli**  
**NEP 2020 P.G. PROGRAMME SESSION 2024-25**  
**Faculty of Science and Technology**  
**Program Name - M.Sc. Sem-III (Microbiology)**

Sr. No.	Course Category	Subject Name	Total Credit	Teaching Scheme (Hrs)			Examination Scheme										Total Marks
				Theory	Pract	Total Hrs.	Theory					Practical					
							UA	CA	Total Mark	Min. Passing	Durati on of Exam (Hrs.)	UA	CA	Total Mark	Min. Passing		
1	Major	Subject-1 Genetics and Molecular Biology (GMB)	04	04	--	04	80	20	100	40	03	--	--	--	--	100	
2		Subject-2 Recombinant DNA Technology (RDT)	04	04	--	04	80	20	100	40	03	--	--	--	--	100	
3		Subject-3 Bioprocess Technology (BT)	04	04	--	04	80	20	100	40	03	--	--	--	--	100	
4		Practical-I Based on subject1,2,3	02	-	04	04	-	-	-	-	-	30	20	50	25	50	
5	Major (Elective)	Any one from Elective basket	02	02	--	02	40	10	50	20	02	--	--	--	--	50	
6		Practical-II Based on Elective paper	02	-	04	04	-	-	-	-	-	30	20	50	25	50	
7		Research Project	04	--	08	08	--	--	--	--	--	60	40	100	50	100	
<b>Total</b>			<b>22</b>	<b>14</b>	<b>16</b>	<b>26</b>	<b>280</b>	<b>70</b>	<b>350</b>	<b>-</b>	<b>-</b>	<b>120</b>	<b>80</b>	<b>200</b>	<b>125</b>	<b>550</b>	

<b>Assessment and Evaluation</b>		
<b>Suggested Continuous Evaluation Methods:</b>		
<b>Internal Assessment (Theory)</b> Continuous Internal Evaluation (CIE)	Class Test, Attendance, Assignment (Charts/Models/Seminar/Rural Service/Report of Excursion/Lab visit/Industrial visit/project or review work)	20
	<b>Total</b>	<b>20</b>
<b>External Assessment</b> Practical Exam	Experimentation, <i>Viva Voce</i> , Spotting etc.	30
Practical Internal	Practical record and others	20
	<b>Total</b>	<b>50</b>
<b>External Assessment</b> University Theory Exam	Section (A) – one Long Question Or Two brief questions	16 X 1=16 8 X 2 = 16
	Section (B) – one Long Question Or Two brief questions	16 X 1=16 8 X 2 = 16
	Section (C) – one Long Question Or Two brief questions	16 X 1=16 8 X 2 = 16
	Section (D) – one Long Question Or Two brief questions	16 X 1=16 8 X 2 = 16
	Section (E) – Four Short Question	4 X 4 = 16
	<b>Total</b>	<b>80</b>
	<b>Project/Dissertation</b>	Project work
	Presentation/Seminar	40
	<b>Total</b>	<b>100</b>

**General Rules and Regulations regarding pattern of question paper for the semester endexamination:**

**A) Pattern of Question Paper**

1. Maximum marks of each theory paper will be 80.
2. Question paper will consist of five questions, each of 16 marks.
3. Four questions will be on four units with internal choice (One question on each unit).
4. Fifth question will be compulsory with questions from each of the four units having equal weightage and there will be no internal choice.

**B) Practical Examination**

1. Practical – I carry 50 marks. The scheme of marking consists of external assessment of 30 marks and internal 20 marks.
2. Practical performance shall be jointly evaluated by the External and Internal Examiner.
3. Duration of practical examination will be as per given in the syllabi of respective subjects.

**C) Project/Dissertation – Students have to prepare and submit the work based on following criteria**

1. Selection of topic
2. Abstract
3. Introduction/Statement Finding
4. Literature review
5. Plan of work/Methodology
6. Conclusion including scope and limitation of study
7. References/Bibliography

The project/dissertation will be of 100 marks which consist of 60 marks for synopsis work and 40 for presentation. Students have to prepare a project file as a synopsis and submit to the head of the department.

**Paper Title**  
**SEMESTER - III**

SEM	Paper Code	Major (Mandatory)	Elective	Paper Code	Research Project	Paper Code
III	STPG03MCB001	Genetics and Molecular Biology (GMB)	1. Food Microbiology and Food Safety (FMFS)	STPG03MCB004	Research Project	STPG03MCB001
			2. Biochemistry (BCH)	STPG03MCB005		
	STPG03MCB002	Recombinant DNA Technology (RDT)	3. Cell Biology (CB)	STPG03MCB006		
			4. Instrumentation and Biotechniques (IBT)	STPG03MCB007		
	STPG03MCB003	Bioprocess Technology (BT)	5. Microbial Metabolism (MM)	STPG03MCB008		
<b>Note: - Student shall select any one from above group</b>						
<b>Practical - I (Based on Major Paper)</b>						
<b>Practical - II (Based on Any one elective paper)</b>						

**SEMESTER - IV**

SEM	Paper Code	Major (Mandatory)	Elective	Paper Code	Research Project	Paper Code
IV	STPG04MCB001	Medical Microbiology and Parasitology (MMP)	1. Virology (VIR)	STPG04MCB003	Research Project	STPG04MCB008
			2. Biostatistics and Bioinformatics (BB)	STPG04MCB004		
	STPG04MCB002	Immunology (IMM)	3. Microbes in Environment (ME)	STPG04MCB005		
			4. Microbial Diagnosis in Health Clinics (MDHC)	STPG04MCB006		
			5. Management of Human Microbial Diseases (MHMD)	STPG04MCB007		
			<b>Note: - Student shall select any one from above group</b>			
<b>Practical - I Based on Major I and II</b>						

# **MAJOR COURSE**



**Semester-III**  
**Paper- STPG03MCB001**  
**Genetics and Molecular Biology (GMB)**

Course Code	Unit	Topic/Title	Credit
03MSCMB01	<b>Unit-I</b>	<b>Replication, Repair and Recombination</b> General concept of Genes, Genome, Recon, Cistron, muton, overlapping genes, genes within genes. Replication—i) Initiation, priming in prokaryotes and eukaryotes, ii) Elongation of DNA chain, holoenzyme, processivity of replication, sub units of DNA pol- III, iii) Termination of replication in prokaryotes and eukaryotes iv) DNA repair - BER, NER and Photoreactivation.	04
	<b>Unit-II</b>	<b>Gene Expression</b> Genetic code-Basic features <b>Transcription</b> - i) Comparative study of prokaryotic and eukaryotic transcription ii) Promoter classes I, II, III, -35 and -10 sequences, iii) RNA Polymerase, iv) Interaction of RNA polymerase with promoter. Initiation of RNA synthesis and promoter escape, v) Elongation of RNA chain. Enhancers and silencers, general and specific factors, vi) Termination of transcription - Extrinsic and intrinsic. <b>Post-transcriptional events</b> - mRNA, rRNA and tRNA processing through splicing mechanism, trans splicing, RNA editing, post transcriptional control of gene expression, RNA interference, catalytic RNA and anti-sense RNA. <b>Translation</b> - Initiation, elongation and termination, mechanisms, post translational modifications. chaperons.	
	<b>Unit-III</b>	<b>Gene Regulation</b> Operon concept, <i>Lac</i> operon, <i>Arabino</i> and <i>trp</i> operon, Chromatin remodeling and mRNA and protein degradation control Regulation of translation - Autogenous control of r-proteins, PhageT <sub>4</sub> Proteins, p32 translational regulation	
	<b>Unit-IV</b>	<b>Gene Recombination</b> Gene recombination - Preliminary concept, Recombination in microbes - transformation, conjugation and transduction Gene mapping in bacteria by - transformation, conjugation and transduction Mapping bacteriophage gene by recombination analysis, deletion mapping and complementation. Transposons: - Bacterial P elements and retroposons	

**Reference Books**

1	Essentials of Molecular Biology by D. Freidfelder
2	Molecular biology by J.D. Watson.
3	Biophysical Chemistry by Chatwal & Anand.
4	Microbial Genetics by D. Freidfelder
5	Microbial Technology by Vol. I & II by A.H. Pepler.
6	Fundamentals of Bacterial Genetics by Nancy Trum and J. Trumphy
7	Principles of Genetics by R.H. Tamarin.
8	Molecular Biology and Genetic engineering by Narayanan.

**Semester-III**  
**Paper- STPG03MCB002**  
**Recombinant DNA Technology (RDT)**

Course Code	Unit	Topic/Title	Credit
03MSCMB02	<b>Unit-I</b>	<b>Techniques and Enzymes in Genetic Recombination</b> Core techniques and enzymes in genetic recombination: restriction endonucleases, type I, II, III, recognition sequences, properties, nomenclature, classification of type II endonucleases, their activity, DNA ligase: properties and specificity, SI nuclease, BAL-31 nuclease, DNA polymerase, polynucleotide kinase, phosphatase, reverse transcriptase, its activity and mode of action, chemical synthesis of DNA, restriction digestion, ligation and transformation.	04
	<b>Unit-II</b>	<b>Cloning Vector</b> Basic strategy of cloning-vectors ( $\lambda$ gt10, $\lambda$ gt11 Bacteriophage, $\lambda$ replacement vectors, phage P1 vector, BACs, YACs, DNA cloning with single stranded DNA vectors, (M13 vectors), Cosmids, plasmid as a vector for gene cloning, phasmids and other advanced vectors, specialist purpose vectors for amplification and for expression (pET vector, pBAD vector), cloning and selection of individual gene, gene libraries: cDNA and genomic libraries, concept of library construction, differences and ideal examples of each library	
	<b>Unit-III</b>	<b>Specialized Cloning Strategies</b> Expression vectors, promoter probe vectors, vectors for library construction-artificial chromosome, recombinant DNA technology with reference to cloning and production of interferon and insulin, Miscellaneous applications of genetically engineered microorganisms (GEMS)/ genetically modified organisms (GMOs)	
	<b>Unit-IV</b>	<b>PCR and DNA Sequencing Method</b> PCR- principle and procedure, optimization of PCR, designing of primers, identification of PCR products, variation in basic PCR- inverse, asymmetrical, multiplex, hot start, ligation mediated, RT, real-time quantitative PCR, DD PCR and immune PCR, applications of PCR, DNA sequencing method-dideoxy and chemical method, sequence assembly, automated sequencing, genome sequencing and physical mapping of genomes	

**REFERENCES:**

1. Singh B.D.(2007), Biotechnology, Kalyani Publisher
2. Mitra (2005). Genetic engineering. Published by Macmillan India Ltd., Chennai.
3. Jogdand SN (2005). Gene biotechnology. Himalaya Publishing House, Mumbai
4. JOGDAND S.N. (2007) Advances in Biotechnology, Himalaya Publishing House, 2007
5. Satyanarayana (2005). Biotechnology. First edition, Books and Allied (P) Ltd., Kolkata.
6. Preeti Joshi (2002). Genetic engineering and its application. First edition, Agrobios (India).
7. Dubey RC (2005). A Text of Biotechnology. Multicolor Illustrative edition, S.Chand and Company Ltd., New Delhi.
8. Bernad R Glick (2003). Molecular Biotechnology - Principles and Applications of Recombinant DNA. Third edition, ASM Press, Washington, D.C.
9. Ramawat K and Shaily Goyal (2010). Molecular Biology and Biotechnology. First edition, S. Chand and company Ltd., New Delhi.
10. Dale J.W., Molecular Genetics of bacteria, 1994, John Wiley & Sons.
11. James D. Watson, Nancy H. Hopkins, Jeffrey W. Roberts, Joan Argetsinger Steitz, Alan M. Weiner

12. Lewin B. 2002 Genes VIII. Oxford.
13. Nancy Hopkins -Microbial genetics:.
14. Freifelder, D., 2000, Molecular Biology, second edition, Naros Publishing House, New Delhi.
15. Lehninger, 2010, Principles of Biochemistry, 5th edn., by Nelson & Cox, W.H. Freeman
16. Watson, J.D. et.al., 2004, Molecular Biology of the Gene, 5th edn., Pearson pub.,
17. Brown, T.A. 2000, Gene Cloning, fourth edition, Chapman and Hall Publication, USA.

**Semester-III**  
**Paper- STPG03MCB003**  
**Bioprocess Technology (BT)**

Course Code	Unit	Topic/Title	Credit
01MSCMB03	<b>Unit I</b>	<p><b>General Principles of Fermentation</b>            Fermentations and Types- Definition of fermentation, industrial fermentations, classification of industrial fermentations based on different criteria Concept of batch and continuous fermentation, mode of conduct of continuous fermentation and its type. Examples of growth associated and non-growth associated fermentations. Bioreactors- i) materials used in construction of fermenters, ii) design and parts of batch fermenter, their functions, iii) Geometry of fermenter, propellers, aerators their types, iv) types of bioreactors –plug flow reactors, CSTR, loop reactors, air-lift, fed batch, fluidized bed reactors, rotary disc reactors, solid-state fermenters. Process optimization—Mass and heat transfer, <math>K_{la}</math>, factors affecting oxygen transfer-rotational speed, rheology, liquid density, oxygen transfer rate, oxygen requirement, Newton number, Reynold number, Power number, mean resistance time, substrate utilization rate, oxygen snag, yield coefficient. Fermentation Kinetics—Growth kinetics and Monods model, specific growth rate, growth limiting substrates, growth yield and kinetics of product formation. Immobilized systems, kinetics of immobilized reactors.</p>	04
	<b>Unit II</b>	<p><b>Downstream Processing and Scale Up</b>            Basic principles of scale up working parameters, geometric constants, Pi-relations. Productivity, power requirements. Downstream processing- i) Bioseparation—filtration, types of filters, membrane filters, centrifugation, sedimentation, flocculation. ii) Purification--- solvent extraction- concurrent &amp; countercurrent extractors with examples. Distillation—single stage and fractional iii) Chromatographic techniques—ion exchange, affinity, gel filtration, adsorption chromatography, principles and applications with examples. iv) Concentration, crystallization, reverse osmosis, ultrafiltration with one example each. v) Drying- techniques and process with example, Storage and packaging.</p>	
	<b>Unit III</b>	<p><b>Industrial Fermentation</b>            Biofuels—Ethanol from different sources such as saccharine, cellulosic, starchy waste by using <i>Saccharomyces cerevisiae</i> &amp; <i>Zymomonas mobilis</i>, r-DNA technology for ethanol production.            Methane production.            Antibiotics—production of Streptomycin, Chloramphenicol, Cephalosporine            Bio preservatives – <i>L. sakei</i>, polyhydroxyalkanoates,            Biopolymers- Dextrans, xanthan            Steroid transformations</p>	

<b>Unit IV</b>	<b>Industrial Production of Enzymes, Acids and Growth Factors</b> Amylases—Deep tank and solid-state fermentation and applications Glucose oxidase – production and applications Lactic acid from whey and its applications, vinegar Vit-B <sub>12</sub> Riboflavin Gibberlins Carotenoides
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### References

1. Industrial Microbiology by A.H. Patel
2. Industrial Microbiology by Prescott & Dunn.
3. Modern Industrial Microbiology & Biotechnology by Nduka Okafoe.
4. Industrial Microbiology: An Introduction by Wastes, Morgan, Rockey and Highten.
5. Industrial Microbiology by Casida.
6. DNA Chromatography by Douglas
7. Ion Chromatography by J. Weiss
8. Encyclopedia of Bioprocessing Technology by M.C. Flickinger & S.W. Drew.

**LAB COURSE**  
**PRACTICALS**  
**SEM III**

**PRACTICAL - I**  
**LAB - I**

1. Detection of gene transfer by transformation in *E. coli*.
2. Detection of gene transfer by conjugation in *E. coli*.
3. Demonstration of transduction.
4. SDS- PAGE and protein separation.
5. Demonstration of UV induced mutagenesis in *E. coli*.
6. Testing of chemicals for mutagenesis by Ames' test
  - 1) Isolation of Genomic DNA from Bacteria.
  - 2) Agarose Gel Electrophoresis.
  - 3) Isolation of Plasmid DNA.
  - 4) Restriction Digestion of  $\lambda$  DNA.
  - 5) Amplification of DNA by PCR.
  - 6) Gene Cloning: - Cloning of GFP Gene
  - 7) Southern Hybridization (Demonstration)
  - 8) RFLP Analysis.
- 9) Determination of microbial kinetics for an inhibitory substrate in a fed batch.
- 10) Determination of Oxygen Transfer Rate (OTR) in submerged fermentation.
- 11) Determination of Specific Growth Rate and Growth yield ( $Y_{x/s}$ ) of biomass production by yeast.
- 12) Product yield for Ethanol production.
- 13) Production of microbial products in Bioreactors
- 14) Amylase and Protease production
- 15) Assay of Amylase and Protease
- 16) Microbiological assays Vit.B<sub>12</sub>/VitB<sub>2</sub>.
- 17) Microbial production of Dextran and assay by spectrophotometric / Viscometric methods.
- 18) Extraction of Aflatoxin by TLC.

**\*Minimum 10 experiments should be performed in the semester**

# **ELECTIVE PAPERS**

**SEM - III**



**ELECTIVE PAPERS**  
**SEM III– STPG03MCB004**  
**Food Microbiology and Food Safety (FMFS)**

Course Code	Unit	Topic/Title	Credit
02MSCMB04	Unit-I	<b>Food Spoilage</b> Introduction to food spoilage Factors affecting food spoilage in general. Spoilage of vegetables and fruits -factors and effects. Spoilage of meat and meat products-factors and effects. Spoilage of poultry products-factors and effects. Spoilage of canned foods- meat and milk products- factors and effects.	02
	Unit-II	<b>Food Safety and Quality Assurance</b> <b>Food infections and intoxications-</b> i) Clostridium ii) <i>B. cereus</i> iii) <i>Salmonella</i> and <i>Shigella</i> iv) <i>Staphylococcus</i> , v) <i>Listeria</i> , vi) <i>Mycotoxins</i> Foods involved, sources of these in food and pathological effects <b>Quality Assurance</b> i) Microbiological quality and standards of food ii) Food safety in food service establishments and other food areas- premises, equipment and utensils, storage, sanitary facilities, cleaning agents, disinfectants and sanitizers, health status of food handlers, waste disposal <b>Food Standards and Regulations in India and abroad</b> i) PFA ii) Food Safety and Standards Act in brief iii) BIS, iv) CODEX Alimentarius v) Risk analysis and HACCP in detail.	
	Unit-III	<b>Food Processing and Preservation</b> Thermal processing - i) Cooking ii) Blanching iii) Commercial sterilization Drying or dehydration -Theory and principles of drying Drying techniques - i) Solar drying ii) Atmospheric drying iii) vacuum drying - tray dryers, tunnel dryers, belt dryers iv) drum dryers, Microwave drying, irradiation. Chemical and naturally occurring antimicrobials. Biosensors in food industry.	
	Unit-IV	<b>Food Fermentations</b> Fermented vegetables - Sauerkraut and Pickles Fermented fish Fermented meat -Sausages Curd and Shrikhand, Probiotic foods- Yoghurt, Applications of probiotic food as nutraceuticals GM Foods	

**Reference Books**

1. Industrial Microbiology by A.H. Patel
2. Industrial Microbiology by Prescott & Dunn.
3. Modern Industrial Microbiology & Biotechnology by Nduka Okafoe.

4. The Book of Citric Acid by A.B. Solunke
5. Industrial Microbiology: An Introduction by Wastes, Morgan, Rockey and Highten.
6. Industrial Microbiology by Casida.
7. DNA Chromatography by Doughlas
8. Ion Chromatography by J. Weiss
9. Encyclopedia of Bioprocessing Technology by M.C. Flickinger & S.W. Drew.

#### **Practicals on Elective Paper - I**

1. Determination of microbial quality of packed foods by BIS methods
2. Proximate Analysis of foods.
3. Determination of TDP.
4. Determination of TDT.
5. Extraction of carotenoids and spectrophotometric assays.
6. Production & assay of Penicillin.
7. Sauerkraut fermentation.
8. Pickle fermentation
9. Production of probiotic food – Curd and Shrikhand
10. Visit to the food industry.

Note – 1. Underlined experiments are considered to be major experiments  
 2. Duration of practical examination will be 4 hours for one day

#### **Distribution of marks for practical examination:**

One major experiment .....	10 marks
Two minor experiments 5 × 2 =	10 marks
Viva-Voce	5 marks
Practical Record	5 marks

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<b>Total .....</b>	<b>30 marks</b>
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**Elective Paper**  
**SEM III– STPG03MCB005**  
**Biochemistry (BCH)**

Course Code	Units	Topic/Title	Credit
03MSCMB05	Unit-I	<p><b>Bioenergetics</b>            First and second laws of Thermodynamics. Definitions of Gibb's Free Energy, enthalpy, and Entropy and mathematical relationship among them, Standard free energy change and equilibrium constant Coupled reactions and additive nature of standard free energy change, Energy rich compounds: Phosphoenolpyruvate, 1,3- Bisphosphoglycerate, Thioesters, ATP</p>	02
	Unit-II	<p><b>Carbohydrates</b>            Families of monosaccharides: aldoses and ketoses, trioses, tetroses, pentoses, and hexoses. Stereo isomerism of monosaccharides, epimers, Mutarotation and anomers of glucose. Furanose and pyranose forms of glucose and fructose, Haworth projection formulae for glucose; chair and boat forms of glucose, Sugar derivatives, glucosamine, galactosamine, muramic acid, N- acetyl neuraminic acid, Disaccharides; concept of reducing and non-reducing sugars, occurrence and Haworth projections of maltose, lactose, and sucrose, Polysaccharides, storage polysaccharides, starch and glycogen. Structural Polysaccharides, cellulose, peptidoglycan and chitin</p>	
	Unit-III	<p><b>Lipid</b>            Definition and major classes of storage and structural lipids. Storage lipids. Fatty acid structure and functions. Essential fatty acids. Triacyl glycerol structure, functions and properties. Saponification Structural lipids. Phosphoglycerates - Building blocks, General structure, functions and properties. Structure of phosphatidylethanolamine and phosphatidylcholine, Sphingolipids: building blocks, structure of sphingosine, ceramide. Special mention of sphingomyelins, cerebrosides and gangliosides Lipid functions: cell signals, cofactors, prostaglandins, Introduction of lipid micelles, monolayers, bilayers</p>	
	Unit-IV	<p><b>Proteins</b>            Functions of proteins, Primary structures of proteins: Amino acids, the building blocks of proteins. General formula of amino acid and concept of zwitterion. Titration curve of amino acid and its Significance, Classification, biochemical structure and notation of standard protein amino acids Ninhydrin reaction. Natural modifications of amino acids in proteins hydrolysine, cystine and hydroxyproline, non-protein amino acids: Gramicidin, beta-alanine, D-alanine and D- glutamic acid Oligopeptides: Structure and functions of naturally occurring glutathione and insulin and synthetic aspartame, Secondary structure of proteins: Peptide unit and its salient features. The alpha helix, the beta pleated sheet and their occurrence in proteins, Tertiary and quaternary structures of proteins. Forces holding the polypeptide together. Human hemoglobin structure, Quaternary structures of proteins</p>	

**Reference Books**

1. Campbell, MK (2012) Biochemistry, 7<sup>th</sup> ed., Published by Cengage Learning
2. Campbell, PN and Smith AD (2011) Biochemistry Illustrated, 4<sup>th</sup> ed., Published by Churchill Livingstone
3. Tymoczko JL, Berg JM and Stryer L (2012) Biochemistry: A short course, 2nd ed., W. H. Freeman
4. Berg JM, Tymoczko JL and Stryer L (2011) Biochemistry, W. H. Freeman and Company
5. Nelson DL and Cox MM (2008) Lehninger Principles of Biochemistry, 5th Edition., W.H. Freeman and Company,
6. Willey MJ, Sherwood, LM & Woolverton C J (2013) Prescott, Harley and Klein's Microbiology by. 9th Ed., McGrawHill
7. Voet, D. and Voet J.G (2004) Biochemistry 3<sup>rd</sup> edition, John Wiley and Sons,

**Elective Paper**  
**SEM III - STPG03MCB006**  
**Cell Biology (CB)**

Course Code	Units	Topic/Title	Credit
03MSCMB06	Unit-I	<p><b>Structure and organization of Cell</b>  <b>Cell Organization</b> – Eukaryotic (Plant and animal, cells) and prokaryotic  Plasma membrane: Structure and transport of small molecules  <b>Cell Wall</b> - Eukaryotic cell wall, Extra cellular matrix and cell matrix interactions,  <b>Cell-Cell Interactions</b> - adhesion junctions, tight junctions, gap junctions, and plasmodesmata (only structural aspects) Mitochondria, chloroplasts and peroxisomes  <b>Cytoskeleton</b>- Structure and organization of actin filaments, association of actin filaments with plasma membrane, cell surface protrusions, intermediate filaments, microtubules</p>	02
	Unit-II	<p><b>Protein Sorting and Transport</b>  <b>Ribosomes, Endoplasmic Reticulum</b> – Structure, targeting and insertion of proteins in the ER, protein folding, processing and quality control in ER, smooth ER and lipid synthesis, export of proteins and lipids.  <b>Golgi Apparatus</b> – Organization, protein glycosylation, protein sorting and export from Golgi Apparatus, Lysosomes</p>	
	Unit-III	<p><b>Cell Signaling</b>  Signaling molecules and their receptors,  Function of cell surface receptors  Pathways of intra-cellular receptors -  a. Cyclic AMP pathway,  b. cyclic GMP  c. MAP kinase pathway</p>	
	Unit-IV	<p><b>Cell Cycle, Cell Death and Cell Renewal</b>  Eukaryotic cell cycle and its regulation,  Mitosis and Meiosis  Development of cancer, causes and types  Programmed cell death  Stem cells, Embryonic stem cell,  induced pluripotent stem cells</p>	

**Reference Books**

1. Hardin J, Bertoni G and Kleinsmith LJ. (2010). Becker's World of the Cell. 8<sup>th</sup> edition. Pearson.
2. Karp G. (2010) Cell and Molecular Biology: Concepts and Experiments. 6<sup>th</sup> edition. John Wiley & Sons. Inc.
3. De Robertis, EDP and De Robertis EMF. (2006). Cell and Molecular Biology. 8<sup>th</sup> edition. Lippincott Williams and Wilkins, Philadelphia.
4. Cooper, G.M. and Hausman, R.E. (2009). The Cell: A Molecular Approach. 5<sup>th</sup> Edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.

**Elective Paper**  
**SEM III - STPG03MCB007**  
**Instrumentation and Biotechniques (IBT)**

Course Code	Units	Topic/Title	Credit
03MSCMB07	Unit-I	<b>Microscopy</b> Brightfield and darkfield microscopy, Fluorescence Microscopy, Phase contrast Microscopy, Confocal Microscopy, Electron Microscopy (Scanning and Transmission Electron Microscopy) and Micrometry.	02
	Unit-II	<b>Chromatography and Spectroscopy</b> Principles and applications of paper chromatography (including Descending and 2-D), Thin layer chromatography. Column packing and fraction collection. Gel filtration chromatography, ion- exchange chromatography and affinity chromatography, GLC, HPLC. Principle and use of study of absorption spectra of biomolecules. Analysis of biomolecules using UV and visible range. Colorimetry and turbidometry.	
	Unit-III	<b>Electrophoresis</b> Principle and applications of native polyacrylamide gel electrophoresis, SDS- polyacrylamide gel electrophoresis, 2D gel electrophoresis, Isoelectric focusing, Zymogram preparation and Agarose gel electrophoresis.	
	Unit-IV	<b>Centrifugation</b> Preparative and analytical centrifugation, fixed angle and swinging bucket rotors. RCF and sedimentation coefficient, differential centrifugation, density gradient centrifugation and ultracentrifugation.	

**Reference Books**

1. Wilson K and Walker J. (2010). Principles and Techniques of Biochemistry and Molecular Biology. 7<sup>th</sup> Ed., Cambridge University Press.
2. Nelson DL and Cox MM. (2008). Lehninger Principles of Biochemistry, 5<sup>th</sup> Ed., W.H. Freeman and Company.
3. Willey MJ, Sherwood LM & Woolverton C J. (2013). Prescott, Harley and Klein's Microbiology. 9<sup>th</sup>Ed., McGraw Hill.
4. Karp G. (2010) Cell and Molecular Biology: Concepts and Experiments. 6<sup>th</sup> edition. John Wiley & Sons. Inc.
5. De Robertis EDP and De Robertis EMF. (2006). Cell and Molecular Biology. 8<sup>th</sup> edition. Lippincott Williams and Wilkins, Philadelphia.
6. Cooper G.M. and Hausman R.E. (2009). The Cell: A Molecular Approach. 5<sup>th</sup> Edition. ASM Press & Sunderland, Washington D.C., Sinauer Associates, MA.
7. Nigam A and Ayyagari A. 2007. Lab Manual in Biochemistry, Immunology and Biotechnology. Tata McGraw Hill.

**Elective Paper**  
**SEM III - STPG03MCB008**  
**Microbial Metabolism (MM)**

Course Code	Units	Topic/Title	Credit
03MSCMB08	Unit-I	<b>Aerobic Respiration</b> Concept of aerobic respiration, anaerobic respiration and fermentation Sugar degradation pathways i.e. EMP, ED, Pentose phosphate pathway TCA cycle Electron transport chain: components of respiratory chain, comparison of mitochondrial and bacterial ETC, electron transport phosphorylation, uncouplers and inhibitors	02
	Unit-II	<b>Anaerobic respiration and fermentation</b> Anaerobic respiration with special reference to dissimilatory nitrate reduction (Denitrification; nitrate/nitrite and nitrate/ammonia respiration; fermentative nitrate reduction) Fermentation - Alcohol fermentation and Pasteur effect; Lactate fermentation (homofermentative and heterofermentative pathways), concept of linear and branched fermentation pathways	
	Unit-III	<b>Microbial Growth</b> Definitions of growth, Batch culture, Continuous culture, generation time and specific growth rate Temperature and temperature ranges of growth, pH and pH ranges of growth, Effect of solute and water activity on growth Effect of oxygen concentration on growth Nutritional categories of microorganisms	
	Unit-IV	<b>Nitrogen Metabolism</b> Introduction to biological nitrogen fixation Ammonia assimilation Assimilatory nitrate reduction, Passive and facilitated diffusion Primary and secondary active transport, concept of uniport, symport and antiport	

**Reference Books**

1. Madigan MT, and Martinko JM (2014). Brock Biology of Microorganisms. 14th edition. Prentice Hall International Inc.
2. Moat AG and Foster JW. (2002). Microbial Physiology. 4th edition. John Wiley & Sons
3. Reddy SR and Reddy SM. (2005). Microbial Physiology. Scientific Publishers India
4. Gottschalk G. (1986). Bacterial Metabolism. 2nd edition. Springer Verlag
5. Stanier RY, Ingrahm JI, Wheelis ML and Painter PR. (1987). General Microbiology. 5th edition, McMillan Press.
6. Willey JM, Sherwood LM, and Woolverton CJ. (2013). Prescott's Microbiology. 9th edition. McGraw Hill Higher Education.

# **Semester IV**





**Gondwana University, Gadchiroli**  
**NEP 2020 P.G. PROGRAMME SESSION 2024-25**  
**Faculty of Science and Technology**  
**Programme Name - M.Sc. Sem IV (Microbiology)**

Sr. No	Course Category	Subject Name	Total Credit	Teaching Scheme (Hrs)			Examination Scheme										Total Marks
				Theory	Practical	Total Hrs.	Theory					Practical					
							UA	CA	Total Mark	Min. Passing	Duration of Exam (Hrs.)	UA	CA	Total Mark	Min. Passing		
1	Major	Subject-1 Medical Microbiology and Parasitology (MMP)	04	04	--	04	80	20	100	40	03	--	--	--	--	100	
2		Subject-2 Immunology (IMM)	04	04	--	04	80	20	100	40	03	--	--	--	--	100	
3		Pract-I	02	-	04	04	-	-	-	-	-	30	20	50	25	50	
4		Pract-II	02	-	04	04	-	-	-	-	-	30	20	50	25	50	
5	Major (Elective)	Any one from Elective Basket	04	04	--	04	80	20	100	40	03	--	--	--	--	100	
		Research Project	06	--	12	12	--	--	--	--	--	90	60	150	75	150	
<b>Total</b>			<b>22</b>	<b>12</b>	<b>20</b>	<b>32</b>	<b>240</b>	<b>60</b>	<b>300</b>	<b>-</b>	<b>-</b>	<b>150</b>	<b>100</b>	<b>250</b>	<b>125</b>	<b>550</b>	

**Paper Title**  
**SEMESTER - IV**

SEM	Paper Code	Major (Mandatory)	Elective	Paper Code	Research Project	Paper Code
IV	STPG04MCB001	Medical Microbiology and Parasitology (MMP)	1. Virology (VIR)	STPG04MCB003	Research Project	STPG04MCB008
			2. Biostatistics and Bioinformatics (BB)	STPG04MCB004		
	STPG04MCB002	Immunology (IMM)	3. Microbes in Environment (ME)	STPG04MCB005		
			4. Microbial Diagnosis in Health Clinics (MDHC)	STPG04MCB006		
			5. Management of Human Microbial Diseases (MHMD)	STPG04MCB007		
			<b>Note: - Student shall select any one from above group</b>			
<b>Practicals - Based on Major I and II</b>						

## Assessment and Evaluation

### Suggested Continuous Evaluation Methods:

<b>Internal Assessment (Theory)</b> Continuous Internal Evaluation (CIE)	Class Test, Attendance, Assignment (Charts/Models/Seminar/Rural Service/Report of Excursion/Lab visit/Industrial visit/project or review work)	20
	<b>Total</b>	<b>20</b>
<b>External Assessment</b> Practical Exam	Experimentation, <i>Viva Voce</i> , Spotting etc.	30
Practical Internal	Practical record and others	20
	<b>Total</b>	<b>50</b>
<b>External Assessment</b> University Theory Exam	Section (A) – one Long Question Or Two brief questions	16 X 1=16  8 X 2 = 16
	Section (B) – one Long Question Or Two brief questions	16 X 1=16  8 X 2 = 16
	Section (C) – one Long Question Or Two brief questions	16 X 1=16  8 X 2 = 16
	Section (D) – one Long Question Or Two brief questions	16 X 1=16  8 X 2 = 16
	Section (E) – Four Short Question	4 X 4 = 16
	<b>Total</b>	<b>80</b>
	<b>Project/Dissertation</b>	Project work
Presentation/Seminar/VIVA		60
<b>Total</b>		<b>150</b>

# **MAJOR COURSE**

**Semester-IV**  
**Paper- STPG04MCB001**  
**Medical Microbiology and Parasitology (MMP)**

Course Code	Unit	Topic/Title	Credit
03MSCMB01	Unit-I	<b>Basic Medical Microbiology</b> Infection, types of infections, infection process, bacteremia, septicemia, pyaemia, sapremia, toxemia. Disease, types of diseases, stages of infectious disease, sign and symptoms. Establishment of causative agent of disease, Koch's postulates, Rivers's postulates. Normal flora of human body, skin, mouth, eye, respiratory tract, digestive tract, urogenital tract, beneficial and harmful roles. Concept of epidemiology, control of communicable diseases. Pathogenicity and Virulence, factors responsible for virulence, attenuation, methods of attenuation.	04
	Unit-II	<b>Clinical Microbiology</b> Collection, isolation and identification of pathogenic bacteria from the specimens a) Blood b) Urine c) Feces/Stool d) Sputum e) Wound/Burn f) CSF g) Throat swab. Study of pathogenic bacteria (morphology, cultural characters, antigenic structure, pathogenesis and Laboratory diagnosis a) <i>Streptococcus pyogenes</i> b) <i>Diplococcus pneumoniae</i> c) <i>Corynebacterium diphtheriae</i> d) <i>Clostridium tetani</i> e) <i>Yersinia pestis</i> F) <i>Coxiella burnetti</i>	
	Unit-III	<b>Medical Mycology</b> Morphology cultural characters, pathogenesis and Laboratory diagnosis of a) <i>Sporotrichum schenckii</i> b) <i>Histoplasma capsulatum</i> c) <i>Blastomyces dermatidis</i> d) <i>Trichophyton rubrum</i> . e) <i>Candida albicans</i> f) <i>Cryptococcus neoformans</i>	
	Unit-IV	<b>Parasitology</b> Study of pathogenic protozoa, helminths and Cestodes. Protozoa- a) <i>E. histolytica</i> b) <i>Leishmania donovani</i> c) <i>Trypanosoma gambiense</i> d) <i>Plasmodium vivax</i> . Helminths and Cestodes: a) <i>Ascaris lumbricoides</i> b) <i>Taenia solium</i> c) <i>Ancylostoma duodenale</i> d) <i>Wuchereria bancrofti</i> e) <i>Schistosoma haematobium</i> .	

**Reference Books**

1	Ananthanarayan R. and Paniker C.K.J. (2009) Textbook of Microbiology. 8 <sup>th</sup> edition, University Press Publication
2	Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. (2013) Jawetz, Melnick and Adelberg's Medical Microbiology. 26 <sup>th</sup> edition. McGraw Hill Publication
3	Goering R., Dockrell H., Zuckerman M. and Wakelin D. (2007) Mims' Medical Microbiology. 4 <sup>th</sup> edition. Elsevier
4	Willey JM, Sherwood LM, and Woolverton CJ. (2013) Prescott, Harley and Klein's Microbiology. 9 <sup>th</sup> edition. McGraw Hill Higher Education
5	Madigan MT, Martinko JM, Dunlap PV and Clark DP. (2014). Brock Biology of Microorganisms. 14 <sup>th</sup> edition. Pearson International Edition
6	Anantha Narayan R. and Paniker C.K.J. (2009) Textbook of Microbiology. 8 <sup>th</sup> edition, University Press Publication
7	Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. (2013) Jawetz, Melnick and Adelberg's Medical Microbiology. 26 <sup>th</sup> edition. McGraw Hill Publication
8	Goering R., Dockrell H., Zuckerman M. and Wakelin D. (2007) Mims' Medical Microbiology. 4 <sup>th</sup> edition. Elsevier

**Semester-IV**  
**Paper- STPG04MCB002**  
**Immunology (IMM)**

Course Code	Unit	Topic/Title	Credit
01MSCMB03	<b>Unit I</b>	<p><b>Basic immunology</b>            Structure and functions of primary and secondary lymphoid organs and lymphoid tissues. Development, structure and functions of lymphoid cells, B-lymphocytes, T-lymphocyte, types of T-lymphocytes, comparison between B and T lymphocyte, other lymphoid cells – macrophage, Ag presenting cells, killer cells. Humoral and cellular immune response, primary and secondary immune response, comparison, mechanism of humoral and cellular immunity, thymus dependent and independent antigens, biological functions active and passive immunity, comparison. Complement system, activation pathways, regulation and biological functions. MHC complex and MHC molecules.</p>	04
	<b>Unit II</b>	<p><b>Antigens, Antibodies and Antigen-Antibody Reaction</b>            Antigen – Complete antigen, hapten, Adjuvant, types of antigens, characters determining antigenicity, Blood group antigens. Antibody – general structure of antibody/Immunoglobulin molecule, digestion, types of immunoglobulins, structure and functions, idiotypic, allotypic determinants, isotypic. Theories of Antibody production, monoclonal antibodies and their applications, hybridoma technology. Antigen-Antibody reactions: Mechanism and applications i) Agglutination ii) Precipitation iii) Complement fixation Other immunological techniques – Immunofluorescence, ELISA, RIA, Western blotting, Southern blotting.</p>	
	<b>Unit III</b>	<p><b>Hypersensitivity and Autoimmunity</b>            Classification of hypersensitivity, Immediate and delayed hypersensitivity, examples pathogenesis of anaphylaxis, Systemic Lupus Erythematosus, Arthus reaction and Serum sickness, immune complex, contact dermatitis, tests to detect hypersensitivity.            Immunological tolerance and Immunosuppression, B-cell tolerance, T-cell tolerance, artificially induced tolerance.            Autoimmunity - causes, autoimmune disorders, types and examples, organ specific and nonorgan specific.            Pathogenesis of Rheumatoid arthritis, Myasthenia gravis, Hashimoto's disease, Graves' disease.</p>	
	<b>Unit IV</b>	<p><b>Tumor and Transplant Immunology</b>            Tumors of lymphoid cell – Lymphoma, Myeloma, Hodgkin disease. Host's immune response to tumor, mechanism, oncogenes and cancer induction, tumor antigens, immune surveillance.            Diagnosis of tumor – biochemical and immunological tumor markers.            Approaches in cancer immunotherapy.            Immunology of graft rejection, Allograft, heterograft, mechanism of graft rejection. Immuno suppressive therapy, specific and nonspecific.            Clinical transplant.</p>	

## References

1. Abbas AK, Lichtman AH, Pillai S. (2007). Cellular and Molecular Immunology. 6th edition Saunders Publication, Philadelphia.
2. Delves P, Martin S, Burton D, Roitt IM. (2006). Roitt's Essential Immunology. 11th edition Wiley-Blackwell Scientific Publication, Oxford.
3. Goldsby RA, Kindt TJ, Osborne BA. (2007). Kuby's Immunology. 6th edition W.H. Freeman and Company, New York.
4. Murphy K, Travers P, Walport M. (2008). Janeway's Immunobiology. 7th edition Garland Science Publishers, New York.
5. Peakman M, and Vergani D. (2009). Basic and Clinical Immunology. 2nd edition Churchill Livingstone Publishers, Edinburgh.
6. Richard C and Geiffrey S. (2009). Immunology. 6th edition. Wiley Blackwell Publication.

**LAB COURSE**  
**PRACTICALS**  
**SEM IV**



**PRACTICAL - I**  
**Based on Paper - I**  
**Medical Microbiology and Parasitology (MMP)**

- 1) Isolation and identification of *S. aureus* from pus/wound/burn.
- 2) Isolation and identification of *Corynebacterium diphtherae* from throat swab.
- 3) Isolation and identification of *M. tuberculosis* from sputum.
- 4) Isolation and identification of *V. cholerae/Sh. dysenteric/ E. histolytica* from stool
- 5) Isolation and identification of *S. typhi* and *S. paratyphi* A B from blood/urine
- 6) Isolation and identification of *N. meningitidis* from C S F
- 7) Isolation and identification of Dermatophytes from skin scrapings.
- 8) Isolation and identification of *P. Vulgaris* from sewage
- 9) Isolation and identification of *E. Coli* from sewage

**PRACTICAL - II**  
**Based on Paper - II**  
**Immunology (IMM)**

- 1) Treponema palladium hemagglutination test (TPHA)
- 2) Diagnosis of Typhoid and Paratyphoid A, B fever by Widal tube test.
- 3) Diagnosis of Hepatis B by Australia latex Antigen test.
- 4) Rheumatoid arthritis (RA) test.
- 5) ELISA test to detect HIV and HBs
- 6) Kahn tube test to detect Syphilis
- 7) Immunoelectrophoresis (Demonstration)
- 8) Quantitative determination of plasma proteins by Immunoelectrophoresis.
- 9) Single radial immunodiffusion (RIA)
- 10) Ouchterlony Immuno- double diffusion.

**Distribution of marks for practical examination:**

One major experiment .....	10 marks
Two minor experiments $5 \times 2 =$	10 marks
Viva-Voce	5 marks
Practical Record	5 marks

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**Total ..... 30 marks**

**\*Minimum 8 experiments should be performed in the semester**

# **ELECTIVE PAPERS**

**SEM IV**

**Semester-IV**  
**Paper-STPG04MCB003**  
**Virology (VIR)**

Course Code	Unit	Topic/Title	Credit
03MSCMB02	<b>Unit-I</b>	Basic Virology History and principle of virology, Origin and evolution of viruses, Differentiation with other group of microorganism, Nomenclature and classification of viruses- criteria used for naming, classification of viruses, recent ICTV classification of viruses (as per 9th edition, 2008), Morphology and structure of viruses- enveloped and non-enveloped viruses, Capsid symmetry icosahedral, polyhedral and helical, Brief account of multiplication of viruses, virus related agents (viroids and prions), modes of transmission of viruses.	04
	<b>Unit-II</b>	Cultivation and Assay of Virus Cultivation of viruses using embryonated egg, experimental animal and cell culture (cell lines, cell strains and transgenic systems), Purification of viruses by adsorption, precipitation, enzymes, serological methods- hemagglutination and ELISA, Assay of viruses: physical and chemical methods (protein, nucleic acid studies, radioactivity tracers and electron microscopy), infectivity assay (plaque method and end point method)	
	<b>Unit-III</b>	Bacterial and Plant Virus Bacterial Viruses- Classification and nomenclature, Bacteriophage structural organization; life cycle: lytic and lysogenic cycle, application of bacteriophages; brief details on M13, Mu, T3, T4, and Lamda P1. Viruses of cyanobacteria, algae, fungi.  Plant Viruses- Classification and nomenclature; Structure and life cycle of plant viruses. Propagation, purification, characterization, identification and genomics of plant viruses like TMV, Cauliflower Mosaic Virus, Gemini virus and Potato Virus X Symptoms of plant virus diseases, Transmission of plant viruses, Viral diseases and their control. Some common viral diseases of plants.	
	<b>Unit-IV</b>	Animal Virus, Antiviral and Viral Vaccine Animal Viruses-Classification and nomenclature; Structure and lifecycle of animal viruses. Replicative strategies employed by DNA and RNA viruses. Epidemiology, pathogenicity, diagnosis, prevention and treatment of picorna, Ortho myxo, Paramyxo, Toga, Rhabdo, Rota, Pox, Herpes, Adeno, Hepatitis, HIV and other Oncogenic viruses; viral vaccines (conventional Vaccines, genetic recombinant vaccines used in national immunization programmes with examples, newer generation vaccines including DNA Vaccines with examples) interferons, and antiviral drugs.	

## REFERENCES:

1. Dimmock, NJ, Easton, AL, Leppard, KN (2007). Introduction to Modern Virology. 6th edition, Blackwell Publishing Ltd.
2. Carter J and Saunders V (2007). Virology: Principles and Applications. John Wiley and Sons.
3. Flint SJ, Enquist, LW, Krug, RM, Racaniello, VR, Skalka, AM (2004). Principles of Virology, Molecular biology, Pathogenesis and Control. 2nd edition. ASM press Washington DC.
4. Levy JA, Conrat HF, Owens RA. (2000). Virology. 3rd edition. Prentice Hall publication, New Jersey.
5. Wagner EK, Hewlett MJ. (2004). Basic Virology. 2nd edition. Blackwell Publishing.
6. Mathews. (2004). Plant Virology. Hull R. Academic Press, New York.
7. Nayudu MV. (2008). Plant Viruses. Tata McGraw Hill, India.
8. Bos L. (1999) Plant viruses-A text book of plant virology by. Backhuys Publishers.
9. Versteeg J. (1985). A Color Atlas of Virology. Wolfe Medical Publication.

**ELECTIVE PAPERS**  
**SEM IV- STPG04MCB003**  
**Biostatistics and Bioinformatics (BB)**

Course Code	Unit	Topic/Title	Credit
02MSCMB04	Unit-I	<p><b>Biostatistics - I</b></p> <p>Basic concepts: definitions – statistics and biostatistics, population, sample, variable and the various types, statistic and parameter.</p> <p>Tabular and diagrammatic presentation – arrays, frequency distribution, bar diagrams, histograms and frequency polygons. Descriptive statistics: measures of central tendency, dispersion, skewness and kurtosis.</p> <p>Probability: definition, elementary properties, types, rules, applications to biological problems, distributions – Binomial, Poisson, Normal, chi-square (<math>\chi^2</math>) distribution and test. Inference about populations: sample size, sampling distribution, standard error, estimation of population mean-confidence interval, Student's t-distribution and its applications (t-test). Sampling methods: principles of sampling, necessity – merits and demerits, random sampling – lottery, geographical arrangement random number; deliberate or nonrandom sampling, stratified sampling, cluster sampling.</p>	04
	Unit-II	<p><b>Biostatistics - II</b></p> <p>Hypothesis testing: definition of hypothesis, hypotheses- null and alternate hypotheses, general procedure, type I and type II errors. Analysis of Variance (ANOVA) : basic concepts, experimental designs – CRD, RBD, factorial experiment, repeated measures, other designs, general method, F-test, multiple comparison tests. Correlation: introduction, types, methods of study – scatter diagram, correlation graph, Karl Pearson's coefficient of correlation and its interpretation, test of significance. Regression: introduction, simple linear regression – model, equation, least-squares line, evaluating and using the multiple regression equation.</p>	
	Unit-III	<p><b>Bioinformatics</b></p> <p>Definition, Components, Databases – definition, biological databases, types and examples data base management. system (DBMS) Biological databases, Primary sequence databases. Composite protein sequence databases, secondary databases, Sequence analysis – Pairwise sequence comparison The biological sequence, expressed sequence tag (EST) Protein Data Bank (PDB) Folding problems, chaperons Sequence analysis. Homology and analogy. Information networks – Web browser, HTTP, HTML and URLs. EMB-net, The national Center for Biotechnology Information – NCBI.</p>	
	Unit-IV	<p><b>Proteomics and Genomics</b></p> <p>protein data bank, Swiss prot, composite protein pattern database. Sequence queries against biological databases BLAST and FASTA, Multiple sequences alignments, Phylogenetic alignment.</p> <p>Genome information resources –DNA sequence databases, specialized genomic resources. DNA sequence analysis – Gene structure and DNA sequences, features of DNA sequence analysis, Issues in the interpretation of EST searches, approaches to gene building expression profile of a cell. cDNA libraries and ESTs, Different approaches to EST analysis- A practical example of EST analysis.</p>	

	Predicting protein structure and function from sequence- Determination of structure secondary and 3D structure protein modeling, Drug discovery and development: Fundamental Principles, rational drug design, role of protein interaction resources, cheminformatics and pharma informatics resources, Pharmacogenomics.
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### Reference Books

1. H. S. Bear: Understanding Calculus, John Wiley and Sons (Second Edition); 2003.
2. E. Batschelet: Introduction to Mathematics for Life Scientists, Springer Verlag, International Student Edition, Narosa Publishing House, New Delhi (1971, 1975)
3. A. Edmondson and D. Druce: Advanced Biology Statistics, Oxford University Press; 1996.  
W. Danial : Biostatistics : A foundation for Analysis in Health Sciences, John Wiley and Sons Inc; 2004.
4. Saxena Sanjay (2003) A First Course in Computers, Vikas Publishing House
5. Pradeep and Sinha Preeti (2007) Foundations of Computing, 4th ed., BPB Publications
6. Lesk M.A.(2008) Introduction to Bioinformatics . Oxford Publication, 3rd International Student Edition
7. Rastogi S.C., Mendiratta N. and Rastogi P. (2007) Bioinformatics: methods and applications, genomics, proteomics and drug discovery, 2nd ed. Prentice Hall India Publication
8. Primrose and Twyman (2003) Principles of Genome Analysis & Genomics. Blackwell

**Elective Paper**  
**SEM III- STPG04MCB005**  
**Microbes in Environment (ME)**

Course Code	Units	Topic/Title	Credit
03MSCMB05	Unit-I	<p><b>Microorganisms and their Habitats</b></p> <p>Structure and function of ecosystems, Terrestrial Environment: Soil profile and soil microflora Aquatic Environment: Microflora of fresh water and marine habitats Atmosphere: Aero microflora and dispersal of microbes.</p> <p>Animal Environment: Microbes in/on human body (Microbiomics) &amp; animal (ruminants) body. Extreme Habitats: Extremophiles: Microbes thriving at high &amp; low temperatures, pH, high hydrostatic &amp; osmotic pressures, salinity, &amp; low nutrient levels.</p>	04
	Unit-II	<p><b>Microbial Interaction</b></p> <p>Microbe interactions: Mutualism, synergism, commensalism, competition, amensalism, parasitism, predation</p> <p>Microbe-Plant interaction: Symbiotic and non-symbiotic interactions</p> <p>Microbe-animal interaction: Microbes in ruminants, nematophagus fungi and symbiotic luminescent bacteria</p>	
	Unit-III	<p><b>Biogeochemical cycling</b></p> <p>Carbon cycle: Microbial degradation of cellulose, hemicelluloses, lignin and chitin Nitrogen cycle: Nitrogen fixation, ammonification, nitrification, denitrification and nitrate reduction Phosphorus cycle: Phosphate immobilization and solubilization Sulphur cycle: Microbes involved in sulphur cycle Other elemental cycles: Iron and manganese</p>	
	Unit-IV	<p><b>Waste Management</b></p> <p>Solid Waste management: Sources and types of solid waste, Methods of solid waste disposal (composting and sanitary landfill)</p> <p>Liquid waste management: Composition and strength of sewage (BOD and COD), Primary, secondary (oxidation ponds, trickling filter, activated sludge process and septic tank) and tertiary sewage treatment</p> <p>Principles and degradation of common pesticides, hydrocarbons (oil spills).</p>	

**Reference Books**

1. Atlas RM and Bartha R. (2000). Microbial Ecology: Fundamentals & Applications. 4<sup>th</sup> edition. Benjamin/Cummings Science Publishing, USA
2. Madigan MT, Martinko JM and Parker J. (2014). Brock Biology of Microorganisms. 14<sup>th</sup> edition. Pearson/ Benjamin Cummings
3. Maier RM, Pepper IL and Gerba CP. (2009). Environmental Microbiology. 2<sup>nd</sup> edition, Academic Press
4. Okafor, N (2011). Environmental Microbiology of Aquatic & Waste systems. 1<sup>st</sup> edition, Springer, New York
5. Singh A, Kuhad, RC & Ward OP (2009). Advances in Applied Bioremediation. Volume 17, Springer-Verlag, Berlin Hedeilberg
6. Barton LL & Northup DE (2011). Microbial Ecology. 1<sup>st</sup> edition, Wiley Blackwell, USA Campbell RE. (1983). Microbial Ecology. Blackwell Scientific Publication, Oxford, England.
7. Coyne MS. (2001). Soil Microbiology: An Exploratory Approach. Delmar Thomson Learning.
8. Lynch JM & Hobbie JE. (1988). Microorganisms in Action: Concepts & Application in Microbial Ecology. Blackwell Scientific Publication, U.K.
9. Martin A. (1977). An Introduction to Soil Microbiology. 2<sup>nd</sup> edition. John Wiley & Sons Inc. New York & London.
10. Stolp H. (1988). Microbial Ecology: Organisms Habitats Activities. Cambridge University Press, Cambridge, England.
11. Subba Rao NS. (1999). Soil Microbiology. 4<sup>th</sup> edition. Oxford & IBH Publishing Co. New Delhi.

**Elective Paper**  
**SEM IV - STPG04MCB006**  
**Microbial Diagnosis in Health Clinics (MDHC)**

Course Code	Units	Topic/Title	Credit
03MSCMB06	Unit-I	<b>Importance of Diagnosis of Diseases</b> Bacterial, Viral, Fungal and Protozoan Diseases of various human body systems, Disease associated clinical samples for diagnosis.	04
	Unit-II	<b>Collection of Clinical Samples</b> How to collect clinical samples (oral cavity, throat, skin, Blood, CSF, urine and faeces) and precautions required. Method of transport of clinical samples to laboratory and storage.	
	Unit-III	<b>Direct Microscopic Examination and Culture</b> Examination of sample by staining - Gram stain, Ziehl-Neelson staining for tuberculosis, Giemsa- stained thin blood film for malaria Preparation and use of culture media - Blood agar, Chocolate agar, Lowenstein-Jensen medium, MacConkey agar, Distinct colony properties of various bacterial pathogens.	
	Unit-IV	<b>Serological and Molecular Methods</b> Serological Methods - Agglutination, ELISA, immunofluorescence, Nucleic acid-based methods - PCR, Nucleic acid probes. Determination of resistance/sensitivity of bacteria using disc diffusion method, Determination of minimal inhibitory concentration (MIC) of an antibiotic by serial double dilution method.	

**Reference Books**

1. Ananthanarayan R and Paniker CKJ (2009) Textbook of Microbiology, 8th edition, Universities Press Private Ltd.
2. Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. (2013) Jawetz, Melnick and Adelberg's Medical Microbiology. 26th edition. McGraw Hill Publication
3. Randhawa, VS, Mehta G and Sharma KB (2009) Practicals and Viva in Medical Microbiology 2nd edition, Elsevier India Pvt Ltd
4. Tille P (2013) Bailey's and Scott's Diagnostic Microbiology, 13<sup>th</sup> edition, Mosby
5. Collee JG, Fraser, AG, Marmion, BP, Simmons A (2007) Mackie and McCartney Practical Medical Microbiology, 14<sup>th</sup> edition, Elsevier.



**Elective Paper**  
**SEM III - STPG04MCB007**  
**Management of Human Microbial Diseases (MHMD)**

Course Code	Units	Topic/Title	Credit
03MSCMB07	Unit-I	<b>Human Diseases</b> Infectious and non-infectious diseases, microbial and non-microbial diseases, Deficiency diseases, occupational diseases, Incubation period, mortality rate, nosocomial infections	04
	Unit-II	<b>Microbial Diseases</b> Respiratory microbial diseases, gastrointestinal microbial diseases, Nervous system diseases, skin diseases, eye diseases, urinary tract diseases, sexually transmitted diseases: Types, route of infection, clinical systems and general prevention methods, study of recent outbreaks of human diseases (SARS/ Swine flu/Ebola) – causes, spread and control, Mosquito borne disease – Types and prevention.	
	Unit-III	<b>Therapeutics of Microbial diseases</b> Treatment using antibiotics: beta lactam antibiotics (penicillin, cephalosporins), quinolones, polypeptides and aminoglycosides. Judicious use of antibiotics, importance of completing antibiotic regimen, Concept of DOTS, emergence of antibiotic resistance, current issues of MDR/XDR microbial strains. Treatment using antiviral agents: Amantadine, Acyclovir, Azidothymidine. Concept of HAART.	
	Unit-IV	<b>Prevention of Microbial Diseases</b> General preventive measures, Importance of personal hygiene, environmental sanitation and methods to prevent the spread of infectious agents transmitted by direct contact, food, water and insect vectors. <b>Vaccines:</b> Importance, types, vaccines available against microbial diseases, vaccination schedule (compulsory and preventive) in the Indian context.	

**Reference Books**

1. Ananthanarayan R. and Paniker C.K.J. (2009) Textbook of Microbiology. 8<sup>th</sup> edition, University Press Publication
2. Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. (2013) Jawetz, Melnick and Adelberg's Medical Microbiology. 26<sup>th</sup> edition. McGraw Hill Publication
3. Goering R., Dockrell H., Zuckerman M. and Wakelin D. (2007) Mims' Medical Microbiology. 4<sup>th</sup> edition. Elsevier
4. Willey JM, Sherwood LM, and Woolverton CJ. (2013) Prescott, Harley and Klein's Microbiology. 9<sup>th</sup> edition. McGraw Hill Higher Education
5. Madigan MT, Martinko JM, Dunlap PV and Clark DP. (2014). Brock Biology of Microorganisms. 14<sup>th</sup> edition. Pearson International Edition