

SHIVAJI UNIVERSITY, KOLHAPUR

SYLLABUS

For
M.Sc. Part II Microbiology

(Semester Pattern)
Sem. III to IV



Estd. 1962

NAAC 'A' Grade

Choice Based Credit System
(CBCS)

To be implemented From

June, 2020 onwards

M.Sc. Microbiology (Horizontal Mobility) CBCS Pattern (2020-21)

M.Sc. Part-II

SEMESTER-III											
	Sr. No.	Course code	Teaching Scheme			Examination Scheme					
			Theory and Practical			University Assessment (UA)			Internal Assessment (IA)		
			Lectures (per week)	Hours (per week)	Credit	Maximum Marks	Minimum Marks	Exam. Hours	Maximum Marks	Minimum Marks	Exam. Hours
CGPA	1	CC-301: Genetic Engineering	4	4	4	80	32	3	20	8	1
	2	CCS-302: Microbial Diversity and Extremophiles	4	4	4	80	32	3	20	8	1
	3	CCS-303: Fermentation Technology-I	4	4	4	80	32	3	20	8	1
	4	DSE-304: Immunology	4	4	4	80	32	3	20	8	1
	5	CCPR-305: Laboratory Course	16	16	8	200*	80	-	-	-	#
Total (C)			-	-	24	520	-	-	80	-	-
Non-CGPA	1	AEC-306	2	2	2	-	-	-	50	20	2
	2	EC (SWMMOOC)-307: Food Microbiology and Food Safety	5	5	4	-	-	-	-	-	-
SEMESTER-IV											
CGPA	1	CC-401: Food and Dairy Microbiology	4	4	4	80	32	3	20	8	1
	2	CCS-402: Microbial Fermentation Technology	4	4	4	80	32	3	20	8	1
	3	CCS-403: Bioinformatics	4	4	4	80	32	3	20	8	1
	4	DSE-404: Medical Microbiology	4	4	4	80	32	3	20	8	1
	5	CCPR-405: Laboratory Course and Project	16	16	8	200*	80	-	-	-	#
Total (D)			-	-	24	520	-	-	80	-	-

Non-CGPA	1	SEC-406	2	2	2	-	-	-	50	20	2
	2	GE-407: Basics of Microbiology	2	2	2	-	-	-	50	20	2
Total (C + D)			-	-	48	1040	-	-	160	-	-

* Practical examination will be Internal/External as per department choice.

Duration of practical examination will be four days (1 Inspection day & 3 Practical days).

I. CGPA course:

1. There shall be 10 Core Courses (CC) per program.
2. There shall be 02 Discipline Specific Elective (DSE) courses of 08 credits per program.
3. There shall be 04 Core Course Specialization (CCS) courses of 16 credits per program.
4. Total credits for CGPA courses shall be of 96 credits per program.

II. Mandatory Non-CGPA Courses:

1. There shall be 02 Mandatory Non-CGPA compulsory Ability Enhancement Course (AEC) of 02 credits each per program.
2. There shall be 02 Mandatory Non-CGPA Compulsory Skill Enhancement Course (SEC) of 02 credits per program.
3. There shall be one Elective Course (EC) (SWAYAM/MOOC). The credits of this course shall be as specified on SWAYAM/MOOC portal.
4. There shall be one Generic Elective (GE) course of 02 credits per program. Each student has to take Generic Elective from the department other than parent department.
5. The total credits for Non-CGPA course shall be of 08 credits+2to 4 credits, as specified of the SWAYAM/MOOC portal.
6. The credits assigned to the course and program shall have no relation with the work load of the teacher.

12. Scheme of teaching and examination

(Applicable to University Department and University affiliated college centers)

The semester examination will be conducted at the end of each term (theory examination only)

Theory paper will be of 80 marks each and 20 marks for internal evaluation test conducted in the mid of the term. Two practical will be of 200 marks each and will be conducted annually.

Question papers will be set in the view of the entire syllabus and preferably covering each unit of the syllabus.

13. Standard of Passing

As per rules and regulations of M.Sc. course.

14. Nature of Question Paper and Scheme of Marking

Nature of question paper and scheme of marking

Theory question paper Maximum marks – 80

Total No. Of question -7

All questions are of equal marks. Out of these seven questions five questions are to be attempted.

Question No.1 is compulsory.

Remaining 6 questions are divided into two sections, namely section-I and Section-II. Four questions are to be attempted for these two sections such that not more than two question from any of the section. Both sections are to be written in the same answer book.

15. Equivalence in Accordance with titles and contents of the papers

M.Sc. Microbiology Semester I and II

Old Course 2013	New Course 2019
SEMESTER - I	
CB 141: Cell Biochemistry (CBCS) (Last Three Attempts)	CC-101A: Cell Biochemistry and Nucleic Acids (CBCS)
LS 141: Cell Biology, Microbiology and Virology (CBCS)	CC-101B: Cell Biology, Microbiology and Virology (CBCS)
BC 141: Proteins: Structure and Functions	CC-102: Proteins: Structure and Functions
BC 142: Biomolecules	CC-103: Biomolecules
-	CC-104A: Basics of Physiology and Endocrinology (CBCS)
BSI 141: Biostatistics and Bioinformatics with Computer Orientation	CC-104B: Biostatistics and Computer Applications (CBCS)
SEMESTER - II	
BC 241: Enzymology	CC-201: Enzymology
MB 241: Molecular Biology	CC-202: Molecular Biology
BC 242: Bioenergetics	CC-203: Bioenergetics
TB 241: Tools and Techniques in Biosciences	CC-204: Tools and Techniques in Biosciences

M.Sc. Microbiology Semester III and IV

Old Course 2014	New Course 2020
SEMESTER – III	
GE 341: Genetic Engineering	CC-301: Genetic Engineering
MIC 341: Microbial Diversity and Extremophiles	CCS-302: Microbial Diversity and Extremophiles
FT 341: Fermentation Technology-I	CCS-303: Fermentation Technology-I
IM 341: Immunology	DSC-304: Immunology
SEMESTER - IV	
MIC 441: Food and Dairy Microbiology	CC-401: Food and Dairy Microbiology
MFT 441: Microbial Fermentation Technology	CCS-402: Microbial Fermentation Technology
BI 441: Bioinformatics	CCS-403: Bioinformatics
MIC 442: Medical Microbiology	DSE-404: Medical Microbiology

Theory question paper format
M.Sc. Part II Microbiology (CBCS)

Total marks: 80

Instructions: 1) Question no.1 is compulsory and carries 16 marks

2) Attempt any two questions from each section

3) All questions carry equal marks

Q.1 Objective/multiple choice/one line sentence type 16 questions (16 Marks)

- i)
- ii)
- iii)
- iv)
- v)
- vi)
- vii)
- viii)
- ix
- x)
- xi)
- xii)
- xiii)
- xiv)
- xv)
- xvi)

Section-I

Q.2 long answer question (16 Marks)

Q.3 long answer question (16 Marks)

Q.4 long answer question (16 Marks)

Section-II

Q.5 short answer questions (16 Marks)

- i)
- ii)

Q.6 Short note answer questions (16 Marks)

- i)
- ii)
- iii)
- iv)

Q.7 Short note answer questions (16 Marks)

- i)
- ii)
- iii)
- iv)

SYLLABUS OF M. Sc. Part II Microbiology DEGREE COURSES OFFERED UNDER HORIZONTAL MOBILITY PROGRAM

**Department of Microbiology
Shivaji University, Kolhapur**

M.Sc. II Microbiology Syllabus

SEMESTER III

600 Marks

- CC 301 : Genetic Engineering**
- CCS 302 : Microbial Diversity and Extremophiles**
- CCS 303 : Fermentation Technology-I**
- DSE 304 : Immunology**
- CCPR 305 : Laboratory Course**
- AEC 306 : Mandatory Non-CGPA Compulsory Ability Enhancement Course**
- EC 307 : (SWMMOOC) Food Microbiology and Food Safety**

SEMESTER IV

600 Marks

- CC 401 : Food and Dairy Microbiology**
- CCS 402 : Microbial Fermentation Technology**
- CCS 403 : Bioinformatics**
- DSE 404 : Medical Microbiology**
- CCPR 405 : Laboratory Course and Project**
- SEC 406 : Mandatory Non-CGPA Compulsory Skill Enhancement Course**
- GE 407 : Basics of Microbiology**

SEMESTER III		
	CC 301: Genetic Engineering	60 Hrs
Unit I	<p>Basics Of Recombinant DNA Technology Restriction analysis: Types of restriction enzyme, Type I, II and III, restriction modification systems, type II restriction endonucleases and properties, isoschizomers and neoschizomers, mcr/mrr genotypes, Cohesive and blunt end ligation, linkers, adaptors, homopolymeric tailing. Labeling of DNA: Nick translation, random priming, radioactive and non-radioactive probes, use of Klenow enzyme, T4 DNA polymerase, bacterial alkaline phosphatase, polynucleotide kinase. Hybridization techniques: Northern, Southern, Western and Colony hybridization, Fluorescence in situ hybridization, Restriction maps and mapping techniques, DNA fingerprinting, chromosome walking & chromosome jumping. DNA-Protein Interactions: Electro mobility shift assay, DNase I footprinting, methyl interference</p>	15
Unit II	<p>Cloning Vectors Gene Cloning Vectors: Plasmids (Natural and synthetic), bacteriophages, M13, MP vectors, phagemids, Lambda vectors; insertion and replacement vectors, EMBL, λDASH, λgt10/11, λZAP etc. Cosmid vectors. Artificial chromosome vectors (YACs, BACs), Animal Virus derived vectors- SV-40, vaccinia/baculo& retroviral vectors. Expression vectors; pMal, GST, pET-based vectors Baculovirus and <i>Pichia</i> vectors system. Applications: His-tag, GST-tag, MBP-tag etc. Restriction proteases, intein-based vectors. Inclusion bodies, methodologies to reduce formation of inclusion bodies.</p>	15
Unit III	<p>Cloning Methodologies Insertion of Foreign DNA into Host Cells: Transformation, Transduction, Conjugation, Transfection: Chemical and physical methods, liposomes, microinjection, macroinjection, electroporation, biolistics, somatic cell fusion, gene transfer by pronuclear microinjection. Plant transformation technology: Basis of tumor formation, hairy root, features of Ti and Ri plasmids, mechanism of DNA transfer, role of virulence genes, use of Ti and Ri as vectors. Cloning and expression in yeasts (<i>Saccharomyces</i>, <i>Pichia</i> etc.), animal and plants cells, methods of selection and screening, cDNA and genomic cloning, expression cloning, yeast two hybrid system, phage display.</p>	15

	DNA Libraries: Construction of cDNA libraries in plasmids and screening methodologies, Construction of cDNA and genomic DNA libraries in lambda vector, jumping libraries. Principles in maximizing gene expression.	
Unit IV	<p>PCR Primer design, Fidelity of thermostable enzymes, DNA polymerases, Types of PCR: multiplex, nested, reverse transcriptase, real time, touchdown, hot start, colony, cloning of PCR products, T-vectors, proof reading enzymes, PCR in gene recombination, deletion, addition, overlap extension, and SOEing, site directed mutagenesis, PCR in molecular diagnostics, viral and bacterial detection, PCR based mutagenesis.</p> <p>Applications Sequencing methods: Enzymatic DNA sequencing, Chemical sequencing of DNA, principle of automated DNA sequencing, NextGene DNA sequencing Methods (SOLiD, Illumina and pyrosequencing), RNA sequencing, Chemical Synthesis of oligonucleotides. Gene silencing techniques: Introduction to siRNA and siRNA technology, micro RNA, construction of siRNA vectors, principle and application of gene silencing. CRISPR, CRISPR/Cas9 technology. Gene knockouts and Gene Therapy: Creation of knockout mice, disease model, somatic and germ-line therapy in vivo and ex-vivo, suicide gene therapy, gene replacement, gene targeting. Other applications: Transgenics, Genome projects and their implications, application in global gene expression analysis. Applications of recombinant DNA technology in medicine, agriculture, veterinary sciences and protein engineering.</p>	15

Suggested readings:

1. Sambrook J, Fritsch E. F. and Maniatis (1989) Molecular cloning, vol. I, II, III, II nd edition, Cold spring harbor laboratory press, New York.
2. DNA Cloning : A practical approach D.M. Glover and D.B. Hames, RL Press, Oxford, 1995
3. Molecular and cellular methods in Biology and Medicine, P.B. Kaufman, W. Wu , D. Kim and L.J. Cseke, CRC Press Florida 1995
4. Methods in Enzymology Guide to Molecular Cloning Techniques, Vol. 152 S.L. Berger and A. R. Kimmel, Academic Press Inc, San Diego, 1996
5. Methods in Enzymology Gene Expression Technology, Vol. 185D. V. Goedel, Academic Press Inc, San Diego, 1990
6. DNA Science: A First Course in Recombinant Technology, D. A. Mickloss and G. A Freyer, Cold Spring Harbor Laboratory Press, New York, 1990
7. Molecular Biotechnology, 2nd Ed. S. B. Primrose, Blackwell Scientific publishers, Oxford, 1994

8. Milestones in Biotechnology, Classic Papers on Genetic Engineering, J. A. Davis and W. S. Reznikoff, Butterworth-Heinemann Boston 1992
9. Route Maps in Gene Technology, M. R. Walker, and R. Rapley, Blakwell Science, Oxford, 1997
10. Genetic Engineering : An Introduction to Gene Analysis and Exploitation in Eukaryotes, S. M. Kingsman, Blackwell Scientific Publications, Oxford, 1998
11. An Introduction to Genetic Engineering, 3rd Edition. Desmond S. T. Nicholl, Cambridge University press, 2008.
12. Gene Cloning and Manipulation, 2nd Ed. Cristopher Howe, Cambridge University Press, 2007.

	CCS 302: Microbial Diversity and Extremophiles	60 Hrs
Unit I	Microbial Ecology: Basic ecological principles, Ecosystems, Habitats, Ecological niches, microbial community, Population dynamics and ecosystem management, mathematical definitions and suitable examples of microbe-microbe interactions, microbe-plant interactions and microbe – animal interactions.	15
Unit II	Microbial taxonomy: Brief study on: Algae: Classification, distribution, structure, nutrition and metabolism, reproduction, importance of Algae. Fungi; Classification, distribution, structure, nutrition and metabolism, reproduction, importance of Fungi. Protozoa ; Classification, nutrition, morphology, reproduction, of protozoa. Viruses; .General properties, classification and reproduction of viruses. Viroids and virusoids, Prions.	15
Unit III	Study of types of Microbes with examples: Concept of autotrophy, Photosynthetic bacteria- Green sulphur bacteria, cyanobacteria classification characteristics of each class, Methanogens- class of Archeabacteria methanogens types and their classification, Methanotrophs- concept and classification, Nitrogen fixing bacteria- Concept of diazotrophy, Classification of N ₂ fixing bacteria as free living and symbiotic and their characteristics. Extremophiles: Concept, adaptation, habitat and significance of Acidophilic bacteria, Halophilic bacteria and Thermophilic bacteria.	15
Unit IV	Microbial interactions with abiotic components and their applications: Other microbial interactions and its controls, with certain abiotic components of environment like wood, plastic, paints, rubber, pesticides, toxic heavy metals, etc.: Biodeteriorations,	15

	Bioremediations, Biotransformations and Biomagnifications and their significance with respect to environment and biodiversity. Role of microbes in secondary and tertiary recovery of petroleum.	
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Suggested Readings

1. Extremophiles (2000) By B.N.Johari, Springer Verlag
2. Microbial Diversity (1999) By D. Colwd, Academic press
3. Microbial Ecology (1979) By J.M. Lynch and N.J.Poole, Blackwell Scientific Publications, Oxford.
4. Introduction to Modern Virology (2001) eds.: N.J.Dimmock and K.N.Leppard, Blackwell Scientific Publications, Oxford.

	CCS 303 A: Fermentation Technology-I	60 Hrs
Unit I	Upstream Processing Microbial cell growth, kinetics and stoichiometry, various methods for growth measurement, strain improvement by mutation, genetic engineering, etc. Overproduction of metabolites, alternative carbon and nitrogen sources and their composition. Development of inocula for industrial fermentation, design of industrial production media. Alternate metabolic routines for utilization of carbon sources with their regulation and inter-linkage especially for glucose and hydrocarbons, preservation and maintenance of microbes.	15
Unit II	Fermentation Design of fermenter, construction materials, various sterilization techniques for solid, liquid and gases, aeration and agitation, foam, auxillarye quipments. Control of various parameters – online and offline monitoring, rheological properties of fermenter, role of computer in fermenter operation.	15
Unit III	Batch, fed-batch, continuous fermentation and solid state fermentation. Effluent treatment, scale up and scale down. Types of fermenters, process economics, fermentation economics.	15
Unit IV	Downstream Processing Principle, methodology, instrumentation and applications of cell homogenization techniques liquid-liquid extraction centrifugation, filtration, , distillation, ultrafiltration, precipitation, adsorption chromatography, ion exchange chromatography, gel filtration and affinity chromatography in clarification, concentration, isolation and purification of various metabolites from fermented media	15

Suggested Readings

1. Moo-Young M. ed. (1985) Comprehensive Biotechnology vol: I & II, Pergamon Press N.Y.
2. Ratledge C and Kristiansen B. eds. (2001) Basic Biotechnology 2nd ed. Cambridge Univ Press Cambridge.
3. Old R.W and Primose S.D (1995) Principles of Gene Manipulation 5th ed. Blackwell Scientific Pub. Oxford.
4. Bailey J.E and Ollis D.F. (1986) Biochemical Engineering Fundamentals 2nd ed. McGraw Hill Book Company, N. Delhi.
5. Aiba S, Humphrey A. E. and N. F. Millis (1973) Biochemical Engineering, 2nd Edition University of Tokyo Press, Tokyo, Japan.
6. Stanbury P.F., Whitaker A, and Hall S.J. (1997) Principles of Fermentation Technology 2nd ed. Aditya Books Pvt. Ltd, N.Delhi.
7. Mukhopadhyaya S.N. (2001) Process Biotechnology Fundamentals. Viva Books Pvt. Ltd. N.Delhi.
8. Rehm H.J and Reed G. (1985) Biotechnology vol. I & II. VCH, Basel.
9. Stainer R. Y. Ingraham J. L., Wheelis M. L. and Painter P. R. (1987) General Microbiology 5th Edition, Macmillan Press Ltd. London.

	DSE 304 : Immunology	60 Hrs
Unit I	<p>Immunology – fundamentals and anatomy of immune system:</p> <p>A) Immunity – Innate and acquired immunity. Components of innate and acquired immunity.</p> <p>B) Antigen, Haptens, adjuvants, mitogens. Antibodies – structure, functions.</p> <p>C) The anatomy of the immune response: - Cells and organs of immune system. Regulation of immune response – Humoral and Cell mediated response.</p>	15
Unit II	<p>Immunity to infection:</p> <p>A) Antigen processing and presentation, MHC, complement system. T and B cell activation.</p> <p>B) Bacterial, viral, protozoan and parasitic infections with reference to (Diphtheria, influenza virus, malaria and helminthes) with specific representative examples of each group.</p> <p>C) Vaccines – Active and passive immunization, DNA vaccines, multivalent subunit vaccines, synthetic peptide vaccines.</p>	15
Unit III	<p>Clinical Immunology:</p> <p>A) Hypersensitivity: - Type I, II, III, and IV reactions. Autoimmunity – organ specific and systemic autoimmune diseases. Treatment of autoimmune diseases.</p> <p>B) Transplantation and tumor immunology: - Graft rejection,</p>	15

	tissue typing, immunosuppressive therapy and clinical transplantation. Tumor antigens, cancer immunotherapy. C) Immunodeficiency diseases - Phagocytic, humoral, cell mediated deficiencies and SCID. AIDS- causes, syndrome, diagnostic tools, treatment and development of vaccine	
Unit IV	Immunotechnology: A) Antigen antibody interactions – Principles, types and applications of agglutination, precipitation, complement fixation, viral neutralization, immunodiffusion, immunoelectrophoresis, ELISA and RIA. B) Monoclonal antibodies – Hybridoma technology and various cellular technologies. C) Automation in immunological techniques – auto analyzers used in immunology, FACS etc.	15

Suggested readings:

1. Kuby : Immunology; RA Goldsby, Thomas J. Kindt, Barbara A. Osborne.
2. Immunology by Roitt I. M., Brostoff J. and Male D. Gower medical publishing London.
3. Fundamentals of immunology 4th ed., Paul 1999, Lippencott Raven.

	CCPR 305: Laboratory Course	(120 hrs) 200 Marks
	Part A	
	1. Screening of antibiotic producers- crowded plate technique 2. Screening of organic acid producers & amine producers 3. Screening of Amylase, Protease & Lipase producers 4. Screening of Vitamin producers 5. Enrichment and isolation of pesticide resistant bacteria from soil 6. Isolation of thermophilic bacteria from soil 7. Isolation of acidophilic and alkalophilic bacteria from soil 8. Isolation of psychrophilic bacteria from soil 9. Isolation of halophilic and halotolerant bacteria 10. Determination of effective dilution of the given disinfectant to disinfect tables & vessels 11. Determination of effective dilution of the given disinfectant for effective disinfection of skin. 12. Determination of preservative effect of the given preservative 13. Determination of potability of the given water 14. Estimation of heterotrophic bacterial count of the given sample. 15. Isolation of lysozyme from egg.	

	Part B	
	1. Production and Estimation of citric acid by <i>Aspergillus niger</i> 2. Transformation 3. Conjugation 4. ELISA and Widal test 5. Western blot. 6. Transduction 7. Protoplast fusion 8. Gene expression	

	<p>9. Preparation of plant tissue culture, formulation of media.</p> <p>10. Isolation of cell wall and study of cell wall polysaccharide by chromatographic technique.</p> <p>11. Laboratory Production of Bacillus thuringiensis insecticide and testing of its efficiency.</p> <p>12. Production of biomass Azotobacter, Rhizobium, Azolla and preparation of biofertilizer from it.</p>
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	AEC 306 : Ability Enhancement Course	30 Hrs
Unit I	Syllabus and nature of paper will be opted as per committee decision.	15
Unit II		15

	EC (SWMMOOC) 307 : Food Microbiology and Food Safety	
Unit I	Syllabus and nature of paper will be opted as per SWAYAM portal.	
Unit II		

SEMESTER IV		
	CC 401: Food and Dairy Microbiology	60 Hrs
Unit I	<p>Contamination, Preservation and Spoilage of different kinds of foods: Cereal products, Sugar products, Vegetables and fruits, Meat and Meat products, Fish, Eggs, Milk and Milk products, Heated canned foods and other Miscellaneous foods. Fermented Foods: Pickles, Fermented soya products, Fermented products like Idli, Dhokla etc. Fermented vegetables -sauerkraut fermentation. Fermented bakery products.</p>	15
Unit II	<p>Food poisoning and infections: Staphylococcal poisoning, botulinal poisoning, Salmonella, Vibrio, Bacillus cereus poisoning. Mycotoxins: Patulin, Aflatoxin, Ochratoxin, Luteoskyrin, Sterigmatocystin, ATA etc. Food borne infections: Study of food borne diseases Sterptococcal infections, Tuberculosis, Shigellosis, Brucellosis, Enteropathogenic viral infections, preventive measures.</p>	15
Unit III	<p>Dairy Microbiology: Cheese fermentation, Fermented Milks, Butter, and other milk products. Indicator organisms. Spoilage and defects of fermented dairy products.</p>	15
Unit IV	<p>Quality control and Regulations of food industry: Microbiological quality control of milk and milk products: ISI standards, FAO/WHO regulations, FDA regulations and APHA/IDF regulations. Principles of HACCP in Food industries, Quality Manuals and documentations for different products, Basic GMP in the industry.</p>	15

Suggested Readings:

1. Food Science (1996) Fifth Edition by Norman and Potter
2. Food Microbiology Frazier
3. Dairy Microbiology by J.S.Yadav, S. Grover, and V.K. Batish

	CCS 402: Microbial Fermentation Technology	60 Hrs
Unit I	<p>Fermentation media: Functions of media components, media rheology and Newton's law of viscosity, Optimization of medium. Gas diffusion: Oxygen and Mass Balance Transfer relationship, Factors affecting gas diffusion Types of fermentations: Solid Surface culture type, Liquid surface culture, submerged fermentations.</p>	15

Unit II	<p>Cultures: Isolation, Screening, Yield improvement by changing culture techniques, Strain improvement and preservation. Growth kinetics and yield kinetics.</p> <p>Controls of fermentation: Principles of control system design, Flux control analysis, Command controls, Biosensors. Fermentation control options- Knowledge based system (KBS), Artificial neural networks (ANN) and Genetic algorithm (GA).</p>	15
Unit III	<p>Modeling of fermentation processes: techniques of mathematical modeling. Process validation and quality assurance: bioprocesses, Approaches and Modeling</p> <p>a) Installation Qualification (IQ), Operational Qualification (OQ), and Performance Qualification (PQ) for laboratory instruments b) Methods of validation and calibration of equipments c) Documentation-importance and significance d) Current Good Manufacturing Practices (CGMP) and Currents Good Laboratory Practices (CGLP)</p>	15
Unit IV	<p>Typical fermentation processes: Industrial production of</p> <p>i) Microbial enzymes ii) Bacitracin iii) Streptomycin vi) Riboflavin v) B-Carotene vi) Gibberellins vii) Surfactants</p>	15

Suggested Readings

1. Fermentation Microbiology and Biotechnology by M. Ei-Mansi and C. Bryce
2. Principles of Fermentation technology by Whitekar, Stanbury and Hall Modelling and Control of fermentation processes by J.R. Leigh
4. Microbial Technology Vol I and II by H. J. Pepler and D. Perlman. Academic Press

	CCS 403: Bioinformatics	60 Hrs
Unit I	<p>Proteomics: Protein Sequence Databases and Analysis Protein sequence information, Primary protein sequence databases, Secondary protein sequence databases, Pair-wise sequence alignment, gaps, gap-penalties, scoring matrices, PAM250, BLOSUM62, local and global sequence alignment, multiple sequence alignment, physicochemical properties using ExPASy, Useful programme; Clustal W.</p>	15

	<p>Proteomics; Structural Databases, Protein Structure Prediction</p> <p>Structural databases; Protein Data bank (PDB), Nucleic Acid Data Bank (NDB), Molecular modeling Data Bank (MMDB). Homology modeling, three-dimensional structure prediction, protein folding and functional sites.</p>	
Unit II	<p>Genomics: Nucleotide Sequence Databases And Analysis</p> <p>Human Genome project (HGP); rough and final draft of HGP, goals of the HGP, genomics. Nucleotide Sequence databases: GenBank, EMBL, DNA Data Bank of Japan (DDBJ). Restriction enzymes, REBASE, Polymerase chain reaction, primer designing, Next Generation Sequencing, application of BioEdit.</p> <p>Genomics: Gene Identification</p> <p>Genome information and special features, coding sequences (CDS), untranslated regions (UTR's), cDNA library, expressed sequence tags (EST), 16S rDNA gene sequencing. Approaches to gene identification; masking repetitive DNA, database search, codon-bias detection, detecting functional sites in the DNA. Internet resources for gene identification. Construction of maps, genetic map, physical map, BLAST.</p>	15
Unit III	<p>Structural Biology</p> <p>Ribose-ring puckering, RNA folding, Ramachandran plot, prediction of α-helix, β-sheet, and 3_{10}-helix, loop modeling, 3-D structure validation, molecular docking, protein-ligand interactions, biophysical aspects of proteins and nucleic acids.</p> <p>Molecular Modeling</p> <p>Functions of molecular modeling. Molecular mechanics, force field, potential energy functions, energy minimization methods, single point calculations, full-geometry optimization, conformational search, , molecular dynamics simulations, molecular modeling packages.</p>	15
Unit IV	<p>Microarrays</p> <p>Concept of microarrays; spotted arrays, oligonucleotide arrays, Applications of microarray technology. Tools and Techniques in proteomics; Isotope Coded Affinity Tags (ICAT), Mass spectroscopy for protein analysis, MALDI-TOF, Electrospray ionization (ESI), Tandem mass spectroscopy (MS/MS) analysis; tryptic digestion and peptide fingerprinting (PMF), profiling and diagnostics, drug target discovery.</p> <p>Phylogenetic Analysis</p> <p>Evolution, phylogenetic tree, methods of phylogenetic analysis; distance based and character based methods, phylogenetic analysis tool- Phylip.</p>	15

Suggested Readings

1. Introduction to Bioinformatics, (Atwood, T. K. and Parry-Smith, D. J).
2. An introduction to Computational Biochemistry. (C. Stain Tsai, A John Wiley and Sons, Inc., publications).
3. Developing Bioinformatics Computer Skills. (Cynthia Gibas and Per Jambeck).
4. Bioinformatics Methods and Applications Genomics, Proteomics and Drug Discovery. (Rastogi S. C. Mendiratta, and Rastogi P.)
5. Bioinformatics, Sequence and Genome Analysis by David Mount, Cold Spring Harbor Laboratory Press, NY, 2004.
6. NCBI Web site: <http://www.ncbi.nlm.nih.gov>

	DSE 404: Medical Microbiology	60 Hrs
Unit I	Virulence: Invasion of pathogens through the different immunological barriers of human body. Establishment of infection. Role of portal of entry of the pathogen. Antigenic variations and virulence. Microbial toxins and super antigens. Carriers of infections. Epidemiology of certain diseases like urino-genital infections, upper respiratory tract infections, dermatological infections and gastro intestinal tract infections. Loss of virulence by many pathogens on subculturing on artificial media.	15
Unit II	Epidemiology: Spread of certain infections in a population. Concept of epidemic, endemic and pandemic spread. Role of socioeconomic conditions in spread of disease. Epidemiological methods- descriptive, analytical and experimental epidemiology. Measurement of infection rate.	15
Unit III	Chemotherapy: Development of drug resistance amongst pathogens – antibiotic resistance mechanisms. Disease management methods. Different prophylactic and therapeutic methods in control of infections.	15
Unit IV	Clinical Microbiology: Collection and transportation of pathological samples with specialreference to samples like Cerebro Spinal Fluid (CSF), Sputum samples, Urine samples and swabs. Certain cultural techniques for pathogens like Dermatophytes, Salmonella, Meningococcus, Leptospira, Mycobacterium, Vibrio, Plasmodium spp, Wucheria bancrofti, and Ascaris lumbricoides. Rapid methods of identification of infection like ELISA, FAT, RIA and Western Blot techniques.	15

Suggested Readings

1. Introduction to Microbiology by Prescott, Harley, Klein
2. Medical Microbiology by Ananthanaryan
3. Medical Microbiology by Dey and Dey

	CCPR 405: Laboratory Course	(120 Hrs) Total: 200 Marks
	Part A	(100 Marks)
	1. Fermentative production of gluconic acid. 2. Bioassay of streptomycin. 3. Fermentative production of wine. 4. Detection of adulteration in common food. 5. Detection of aflatoxin in food and feed. 6. Chemical analysis of food – pH, benzoate, sorbate and colour. 7. Microbiological –MPN, Resazurin. Chemical – pH, fat, protein, sugar and ash, Physical – sp. gravity, different solid, test for grading of milk. 8. Platform test in dairy industry – COB, alcohol precipitation, titrable acidity test, quantitative phosphatase test. 9. Using RasMol through command line. 10. Pair-wise sequence alignment. 11. Multiple sequence alignment. 12. Introduction of BioEdit. 13. Construction of three-dimensional model by using SPARTAN 14. Model Building and Energy minimization. 15. Molecular Docking and Drug designing. 16. Production of amylase	
	Part B	(100 Marks)
	Research Project	

	SEC 406 : Skill Enhancement Course	30 Hrs
Unit I	Syllabus and nature of paper will be opted as per committee decision.	15
Unit II		15

	GE 407 : Basics of Microbiology	30 Hrs
Unit I	<p>Introduction to Microbiology: Origins of Microorganisms, differences between eukaryotic and prokaryotic cells, Types of microorganisms, Beneficial and harmful activities of microorganisms. Bacterial cell structure and its physiology. Microbial growth: growth curves, Bacterial nutrition, Culture media</p>	15
Unit II	<p>Techniques in microbiology: Pure culture techniques: streak plate, pour plate, spread plate, Microscopy. Isolation of aerobic and anaerobic bacteria, Control of microorganisms: different methods such as physical and chemical, disinfection, antimicrobial test. Stains and staining techniques: definition and types of stains, monochrome and Gram staining</p>	15

Suggested readings:

1. Introduction to Microbiology by Prescott, Harley and Keim
2. Microbiology by Pelczar