Syllabus Book

1st to 4th Semester

M. Sc.

Microbiology

P P Savani University

School of Sciences

Effective From:July 2022

Authored by: P P Savani University

Sem-1

Course Code: SSMB7010

Course Name: Advances in Molecular biology

Prerequisite: Nil

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
4	0	0	4	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:
The students will acquire the fundamental knowledge about Molecular biology, use of microorganisms, their DNA organization, genome structure, enzymes helpful in technology, gene expression, regulations and its applications. To inculcate habit of scientific reasoning, to do the task rationally.

Course Contents:

Section-I			
Module	**Content**	**Hours**	**Weightage (%)**
1	**DNA structure** DNA structure: Chemistry of DNA, DNA structure, Importance of hydrogen bonding, DNA usually right-handed double helix, Major & minor grooves, Different conformations of DNA (B, A and Z), Denaturation and Renaturation of DNA. DNA topology: linking number, twist, writhe, Supercoiling, Biology of Supercoiled DNA, DNA topoisomerases and their mechanism of action.	10	15
2	**Organization of genome & replication** Organization of DNA into chromosomes: Packaging of DNA and organization of chromosome in bacterial cells; Packaging of DNA in eukaryotic nucleosome and chromatin condensation, Nucleosome are building blocks, Histones, organization of histone octamer, atomic structure of nucleosome, histone wrapping around octamer, Histone binds to linker DNA, importance of Histone N-terminal tail for formation of 30nm fiber, chromatin remodelling, Histone modification, Acetylation-deacetylation-methylation-demethylation-phosphorylation of histone, enzymology of histone modification **DNA replication:** Chemistry of DNA synthesis, synthesized by 3' end of the primer, driving force of DNA synthesis, Replicon, extrachromosomal replicon, Function of DNA helicase, Single stranded binding protein, Topoisomerase, DNA polymerase enzymes: structure, holozymes has three sub complex, sliding clamp functions, replication fork, clamp control association of core enzymes with DNA, coordinating synthesis of leading and lagging strand, RNA priming required to start replication, okazaki fragments, DNA polymerase in bacteria and eukaryotes, Proof reading activity, Termination of DNA replication: Type II topoisomerase, telomerase	25	45
Section-II			

3	**Expression of Genome** Promoters, Transcription binding protein, Transcription factors, Enhancers, **Transcription:** Different forms of RNA polymerases and its features, Activation of transcription by series of steps, Protein-protein interaction, DNA binding domains: zinc finger motif & helix loop helix, transcription in prokaryotes and eukaryotes, chemistry of RNA splicing, spliceosome machinery, splicing pathways, Exon shuffling, RNA editing, mRNA transport. **Genetic code:** makeup of code, characteristics of triplet codon, wobble hypothesis, three codon lead to chain termination, cracked code, universal nature of code **Translation:** Characteristics of mRNA, structure and role of t-RNA in protein synthesis, attachment of amino acids to tRNA, ribosome structure, Larger and smaller submit association and dissociation, translation -initiation, elongation and termination in in prokaryotes & eukaryotes.	13	20
4	**Regulation of gene expression** Regulation of gene expression in prokaryotes: Operon concept, positive and negative regulation. Examples of lac, ara, and trp operon regulation. Regulation of gene expression in eukaryotes: Transcriptional: Modification of histone and DNA, Antisense RNA, si RNA, mi RNA, RNAi, translational: Post translation modification, chaperones, hsp 70, protein folding.	12	20

Reference Books:

Title	Authors	Publisher
Molecular biology of gene	Watson, baker, bell	5th edition, Pearson
Genes IX	Lewin	Jones and Bart let
Principles of genetics	Gardner, Simmons, Snustad	8th edition, Wiley

Course Code: SSMB7030

Course Name: Advances in Microbial genetics

Prerequisite: Nil

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
4	0	0	4	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:
The students will acquire the fundamental knowledge about Advances in molecular and microbial genetics, mutations, types, its applications, transformation, conjugation, plasmid biology and various transgenic mechanisms and its applications.
To inculcate habit of scientific reasoning, to do the task rationally

Course Contents:

Section-I			
Module	**Content**	**Hours**	**Weightage (%)**
1	**Mutation and DNA Repair:** Mutation, Spontaneous mutations DNA damages (Deamination of bases, alkylation, damage due to reactive oxygen, UV induced damage) and it repair pathways (Methyl-directed mismatch repair, Nucleotide excision repair, Base excision repair, recombinational repair, SOS inducible repair, specific repair for oxidative DNA damage, pyrimidine dimers and alkylation induced damage and adaptive response). **Recombination** (Types, Models of homologous recombination, Molecular mechanism of homologous, Homologous recombination in eukaryotes, mating type switching, Site specific recombination and its biological significance)	15	25
2	**Plasmid Biology** (Types of plasmids, compatibility, regulation of plasmid copy number and plasmid segregation) **Phage genetics** (T-series, complementation and Fine structure analysis, biology of lambda phages) **Fungal Genetics** (Tetrad analysis and Mitotic recombination) Model Organisms (Bacteriophage, *E. coli*, *Saccharomyces cerevisiae*, *C.elegans*, *Droshophilla*, *Arabdopsis thaliana*)	15	25
Section-II			
3	**Transformation** (Natural transformation in *Bacillus subtilis*, *Streptococcus pneumonia* and *Haemophilus influenza*). Transformation by inducing artificial competence, Gene linkage and mapping by transformation. **Transduction** (Generalized transduction in P22, P1, T4 and Mu bacteriophages, homologous recombination with recipient's chromosome, measuring transduction (co-transduction of markers, marker effects, abortive transduction, transduction of plasmids).	15	25

	Applications of generalized transduction, Specialized transduction and its applications. **Conjugation** (F-factor mediated Conjugation in *E. coli*, Hfr conjugation and chromosomal transfer, F-prime conjugation and merodiploids, Conjugation of fertility inhibited F-like plasmids, Non conjugative mobilizable plasmids, chromosomal mobilization of non-F plasmids, Plasmid based conjugation in other bacteria (*Salmonella, Pseudomonas*, *Streptomyces and streptococcus*, Interrupted mating and conjugational mapping)		
4	*Agrobacterium* genetics: Ti plasmid, Interkingdom gene transfer (Key early experiments, vir regulon, protein secretion apparatus, conjugation model of T-DNA transfer, Integration products) Transposable elements: Types of bacterial transposable elements; Structure, genetic organization and mechanism of transposition of Tn5, Tn3, phage Mu, Tn7, IS911, Integrons, Retrotransposons, conjugative and mobilizable transposons, Assays of transposition.	15	25

Reference Books:

Title	Authors	Publisher
Molecular Biology of the Gene	Watson et al	Vth edition.
Modern Microbial Genetics	UldisStreips and Ronald Yasbin	Wiley publication
Microbial genetics	StanleyMolay, John Cronan and David Freifelder	Narosa Publishing House (1990)
Molecular Genetics of Bacteria	Snyder and Champness	American Society for Microbiology; 2nd Revised edition edition (1 December 2002)
Molecular Genetics	Stent and Calendar	W.H.Freeman& Co Ltd; 2nd Revised edition edition (4 December 1978)
Principles of Genetics	Gardener, Snustad and Simmons	Wiley India Pvt. Limited, 2006
Genes IX	Lewin	Jones and Bartlett Publishers, Inc; 9th Revised edition edition (6 March 2007)

Course Code: SSMB7070

Course Name: Advances in Biochemistry

Prerequisite: Nil

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
4	0	0	4	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:
The students will acquire the fundamental knowledge about Advances in biochemistry, bimolecular structure, Carbohydrate Metabolism, Nucleic acids, amino acids and vitamin metabolism and its applications.
To inculcate habit of scientific reasoning, to do the task rationally

Course Contents:

Section-I			
Module	**Content**	**Hours**	**Weightage (%)**
1	**Basic Biochemistry:** Introduction to biomolecules, structure and biological significance of the different biomolecules. Nomenclature and classification of enzymes; enzyme Kinetics: Uni substrate enzyme kinetics, factors affecting the rate of enzyme catalyzed reactions; forms and derivation of Michaelis-Menten's equation, significance of Vmax and Km; Enzyme inhibition- reversible and irreversible (competitive, non-competitive and uncompetitive). General regulations of various metabolic pathways (Feedback, Allosteric, Covalent Modification).	15	25
2	**Carbohydrate Metabolism:** Overall pathways and regulation of different carbohydrate metabolism (Glycolysis, Gluconeogenesis, Pentose phosphate Pathway, TCA, Glycogenesis and glycogenolysis)**.** Interaction of carbohydrate molecule with membrane receptor proteins.	15	25
Section-II			
3	**Lipid Metabolism:** Fatty acid synthesis and oxidation, Metabolism of phospholipids, triglycerides and cholesterol molecules. Interaction of different lipid molecule with membrane receptor proteins and their regulation.	15	25
4	**Amino acids and Nucleic acid Metabolism:** **Amino acids:** Overall pathways and regulation of amino acid metabolism (Transamination, Deamination, Specific reactions – Oxidation / decarboxylation and Urea cycle). Biogenic amines formation and their involvement in metabolism. Interaction of different amino acid with membrane receptor proteins. **Nucleic acid:** Catabolism and anabolism of purines and pyrimidines and their regulation. De novo synthesis of nitrogen bases.	15	25

Reference Books:

Title	Authors	Publisher
Lehninger Principles of Biochemistry	Nelson David L & Cox, Michael M. W. H. Freeman and Company	5th Edition. ISBN: 978-0-2302-2699-9
Harpers's Biochemistry	Harper	Mc Graw Hill Publishing Company. 27th Edition. ISBN 10: 0071461973
Fundamentals of Biochemistry	Voet , Donald & Pratt, Charlotte W.	John Wiley and Sons, Inc, New York, 2rd Edition. ISBN: 0-471-74268-6
Biochemistry	LubertStryer	W. H. Freemand and Company. 6th Edition. ISBN-0716720094
Textbook of Medical Biochemistry	Chatterjee M.N and Rana Shinde	Jaypee Brothers Medical Publisher PVT Ltd. ISBN – 8184481349.
An Introduction of Practical Biochemistry	Plummer, David T	Tata McGraw-Hill Publishing Co. Ltd, New Delhi., ISBN: 0-07-099487-0.
Textbook of medical Laboratory Technology	Praful B. Godkar	BhalaniPulishing house, Mumbai. 2nd Edition. ISBN – 81-85578-10-9

Course Code: SSMB7090

Course Name: Microbial Diversity

Prerequisite: Nil

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
4	0	0	4	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:
The students will acquire the fundamental knowledge about Microbial diversity, morphological, structural diversity, Nucleic acid diversity and their survival due to diversifications and its applications.
To inculcate habit of scientific reasoning, to do the task rationally

Course Contents:

Section-I			
Module	**Content**	**Hours**	**Weightage (%)**
1	**Microbial diversity:** What is microbial diversity, types of diversity: morphological, structural, metabolic, ecological, fundamental similarity of organisms, cultivable and noncultivable diversity, conservation of microbial diversity	15	25
2	**Bacterial diversity:** occurrence, diversity, Survival, adaptation strategies characteristics, significance of various groups of bacteria **Archaeal Diversity:** occurrence, diversity, characteristics, survival, adaptation & significance and application of various groups of archaea Actinomycetes Diversity: occurrence, diversity, characteristics, survival, adaptation & significance and application of various groups of actionomycets	15	25
Section-II			
3	**Fungi and Algae diversity:** Physiological variation, identification, cultivation, Characterisitics and classification of important groups of Fungi and algae. Economical importance of fungi and algae	15	25
4	**Methods of studying microbial diversity** **Conventional methods:** staining, microscopy, Cultivation method, culturing characteristics, estimation of important molecules. **Molecular Methods:** DNA polymorphism, SNP, r-RNA sequence, PCR based techniques, RFLP, RAPD, AFLP, Microsatellite, DNA barcoding	15	25

Reference Books:

Title	Authors	Publisher
Brock Biology of Microorganisms	Madigan, Martinko, Stahl	Benjamin-Cummings Pub Co; 13

		edition
Prescott's, Microbiology	Christopher J. Woolverton, Linda M. Sherwood, Johanne M. Willey	McGraw Hill Education; 8 edition
Principles of Microbiology	R.M Atlas	8th edition, wiley
Molecular and Cellular Biology	Cavicchioli, R. Archaea	ASM Press, Washington, 2007
The Prokaryotes.Vol. I – VII	Dworkin, M., Falkow, S., Rosenberg, E., Schleifer, K.H., Stackebrandt, E. (Eds.).	Springer, 2006.
Bergey's Manual of Systematic Bacteriology, 2nd edition, Vol. I	Garrity, G.M. and Boone, D.R. (Eds.)	Springer, 2001
Bergey's Manual of SystematicBacteriology, 2nd edition, Vol. II,	Garrity, G.M., Brenner, D.J., Kreig, M.R. and Staley, J.T. (Eds.),	Springer, 2005
Physiology and Biodiversity of Extremophiles	Gerday, C. and Glansdorff, N.	ASM Press, Washington, 2007

Course Name: Molecular Biology, Physiology and Genetics

Course Code: SSMB7110

Prerequisite: Nil

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
0	8	0	8	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

The students will acquire the fundamental basics and practical knowledge of Molecular biology, nucleic acid estimation, its techniques,enzymes, various organisms producing enzymes, activities and its applications.
To inculcate habit of scientific reasoning, to do the task rationally.

Course Contents:

Section-I		
Module	**Content**	**Hours**
1	Principle and utility of microscopy and micrometry to study cell structure and cell size.	8
2	Study of *Serratia marescens* pigmentation under UV light- Dark and photoreactivation.	8
3	Isolation of antibiotic resistant mutants by chemical mutagenesis	8
4	Quantitative estimation of DNA by DPA	8
5	Quantitative estimation of RNA by Orcinol	8
6	Agarose gel electrophoresis of DNA	8
7	Isolation of Plant DNA	8
8	Isolation of Fungal DNA	8
9	Isolation of Bacterial DNA	8
10	Amplification of isolated nucleic acid by PCR	8
11	To isolate and Study Blue white screening for lactose org/ Diauxic growth curve.	8

Course Name: Genomics, Proteomics and Microbial Diversity

Course Code: SSMB7130

Prerequisite: Nil

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
0	8	0	8	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

The students will acquire the fundamental basics and practical knowledge of genetics, pedigree analysis, mutations, genetic disorders, environment helpful organisms, methanogens, fungal, algal and protozoal diversity, activities and its applications.
To inculcate habit of scientific reasoning, to do the task rationally.

Course Contents:

Section-I		
Module	**Content**	**Hours**
1	Pedigree Analysis.	8
2	Study of Ethical Issues in Medical Genetics.	8
3	DNA isolation from Human Blood and Electrophoresis	8
4	Human Genome Project and Practical Applications.	8
5	Isolation of thermophiles from hot water spring.	8
6	Isolation of halophiles from sea water.	8
7	Isolation of alkalophiles from sample.	8
8	Isolation of methanogens from waste dump.	8
9	Isolation of Acidothiobacillus ferrooxidans and Acidothiobacillus thiooxidans from metal sulfides and acid mine water.	8
10	To isolate and Study Fungal Diversity from different niches.	8
11	To isolate and study Algal Diversity from various aquatic samples	8
12	To isolate and Study Protozoal Diversity from various niches	8

Sem-2

Course Code: SSMB7020

Course Name: Immunotechnology

Prerequisite: Nil

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
4	0	0	4	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:
The students will acquire the fundamental knowledge about Immuno technology,various immune organs and cells of body, fundamentals, immune effectors, mechanisms, monoclonal antibodies, hybridoma technologies and its applications.
To inculcate habit of scientific reasoning, to do the task rationally

Course Contents:

Section-I			
Module	**Content**	**Hours**	**Weightage (%)**
1	**Fundamentals of Immunology (Part 1):** Historical Perspective of Immunology, Cells and Organs of Immunology, Antigen, Antibody structure and function, Innate Immunity, Acquired Immunity.	15	25
2	**Fundamentals of Immunology (Part 2):** Antigen Processing and Presentation; B-Cell Generation, Activation, and Differentiation; T-Cell Maturation, Activation, and Differentiation	15	25
Section-II			
3	**Immune Effector Mechanisms:** Cytokines, Complement System, Cell-Mediated Effector Responses, Hypersensitive Reactions, Inflammation	15	25
4	**Applied Immunology:** Monoclonal and Polyclonal antibodies, Hybridoma Technology, Monoclonal and Polyclonal antibodies, Immunodeficiency disorder, Autoimmune diseases, Transplantation Immunology, Tumor Immunology	15	25

Reference Books:

Title	Authors	Publisher
Kuby Immunology	Thomas J. Kindt, Richard A. Goldsby, Barbara A. Osborne	W.H. Freeman & Company
Basic Immunology: Functions and Disorders of the Immune System	Abul K. Abbas, Andrew H.Lichtman	W.B. Saunders Company
Roitt's Essential Immunology	Peter J. Delves , Seamus J. Martin, Dennis R. Burton	Willey Blackwell

Course Code: SSMB7040

Course Name: Bioinstrumentation

Prerequisite: Nil

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
4	0	0	4	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:
The students will acquire the fundamental knowledge about Instruments, their mechanism, principles, use and its applications.
To inculcate habit of scientific reasoning, to do the task rationally

Course Contents:

Section-I			
Module	**Content**	**Hours**	**Weightage (%)**
1	**Chromatography**: Adsorption and partition chromatography, Size Exclusion, Ion Exchange, Affinity, HPLC, Gas Chromatography	15	25
2	**Spectroscopy:** Electromagnetic radiation, types: U.V visible absorption spectroscopy. IR Spectroscopy, NMR, Raman Spectroscopy	15	25
Section-II			
3	**Cytological & Molecular Biology methods (part-1):** Flow cytometry, Nuclear Acid Hybridization/Blotting and types, FISH, DNA microarray	15	25
4	**Cytological & Molecular Biology methods (part-2):** PCR and its modification, Site-directed mutagenesis, Gene and Genome editing tools(RNAi, CRISPER-Cas, ZFN, TALENS)	15	25

Reference Books:

Title	Authors	Publisher
Principles and Techniques of Biochemistry and Molecular Biology	Wilson and Walker	Cambridge Press
Biophysical Chemistry	Upadhyay, Upadhyayand Nath	Himalaya Publishing House

Course Code: SSMB7080

Course Name: Bioprocess Technology

Prerequisite: Nil

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
4	0	0	4	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

Course Contents:

Section-I			
Module	**Content**	**Hours**	**Weightage (%)**
1	**Introduction to Bioprocess Technology:** Isolation and Screening of Microorganisms, Strain Improvement, Maintenance of Industrial Cultures, Growth Phases of Microorganisms, Effect of Environmental Factors on growth, Growth Kinetics, Measurement of Growth, Preservation of Industrially important organisms	15	25
2	**Up Stream Process:** Fermentation substrates used in media formulation, Optimization of media, Inoculum development, Solids and liquid handling, Sterilization of media, air, reactors, Aeration, agitation and maintenance of optimum fermentation condition, Batch, fed batch and continuous cultivation	15	25
Section-II			
3	**Down Stream Process:** Characterization of products and by-products, Methods of Cell Separation, disruption, Product Recovery, Purification, Antibiotics, Biopolymers , Role of enzymes and applications inindustries	15	25
4	**Role of industrial important enzymes:** Product enrichment techniques, Product purification techniques, Immobilized enzymes, Bioreactors, its types, Applications, Bioprocess economics	15	25

Reference Books:

Title	Authors	Publisher
Principles of Fermentation Technology A. Whitekar, P. F. Stanbury& S. J.	Principles of Fermentation Technology A. Whitekar, P. F. Stanbury& S. J.	Principles of Fermentation Technology A. Whitekar, P. F. Stanbury& S. J.
Hall	Hall	Hall
Butterworth-	Butterworth-	Butterworth-

Course Code: SSMB7100

Course Name: Enzyme Technology

Prerequisite: Nil

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
4	0	0	4	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:

The students will acquire the fundamental knowledge about Enzyme technology,various enzyme assays, enzyme kinetics, regulation, immobilization and its applications.
To inculcate habit of scientific reasoning, to do the task rationally.

Course Contents:

Section-I			
Module	**Content**	**Hours**	**Weightage (%)**
1	**Basics of Enzymology:** Definitions, Brief nomenclature and classification of enzymes, Enzyme assays,Isoenzymes, Monomeric and oligomeric enzymes,Enzymelocalization, Multienzyme complex, Methods for purification ofenzymes	15	25
2	**Enzyme Kinetics:** First order and second order reaction, Significance of activation energy, Km, Vmax, Turnover number, Kcat, Transformation of M M equation (Line weaver-Burk plot, Eadie - Hofstee plots, Hanes plots), Kinetics of multi substrate reactions (Ping-pong bi-bi mechanism), Mechanism of catalysis of Enzymes- Serine proteases, Chymotrypsin, Triose phosphate isomerase	15	25
Section-II			
3	**Enzyme regulation:** General mechanism of enzyme regulation, Allosteric enzymes, Sigmoidal Kinetics and significance, Symmetric and sequential modes for action of allosteric enzymes and their significance, Reversible and irreversible covalent modifications of enzyme, Proteolytic Activation, Feed Back Inhibition	15	25
4	**Immobilization and Applications enzymes:** Methods of enzyme immobilization, Effect of immobilization on enzyme activity, partitioning/ diffusion limitations, Importance of Immobilization, Study of Industrial important enzymes, Enzyme as a biosensor, Case study	15	25

Reference Books:

Title	Authors	Publisher
Fundamentals of Enzymology	Nicholas Price & Lewis Stevens	Oxford Univ. Press
Enzymes	Trevor Palmer	East-West Press
Biochemistry	Donald Voet, Judith G. Voet	John Wiley & Sons
Lehninger, Principles of Biochemistry	Nelson, D. L., Lehninger, A. L., & Cox, M. M.	W. H. Freeman and Company
An introduction to practical biochemistry	Plummer, D	McGraw-HILL

Course Name: Bioinstrumentation and Immunological Methods

Course Code: SSMB7060

Prerequisite: Nil

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
0	8	0	8	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:
The students will acquire the fundamental basics and practical knowledge about Immunotechnology,various instruments, technologies, identification and its applications.
To inculcate habit of scientific reasoning, to do the task rationally

Course Contents:

Section-I		
Module	**Content**	**Hours**
1	To study the absorption spectrum of different plant pigments.	8
2	Optimization of PCR conditions for amplification of bacterial 16S rRNA	8
3	Identification of bacterial isolates using universal primers	8
4	Sodium dodecyl sulfate -polyacrylamide gel electrophoresis	8
5	Double immunodiffusion technique	8
6	Total white blood cell count	8
7	Purification of immunoglobulin (IgG)	8
8	Visit to advanced instrumentation lab	4

Course Name: Bioprocess and Enzyme Technology Methods

Course Code: SSMB7120

Prerequisite: Nil

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
0	8	0	8	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:
The students will acquire the fundamental basics and practical knowledge enzymes, various organisms producing enzymes, activities and its applications.
To inculcate habit of scientific reasoning, to do the task rationally.

Course Contents:

Section-I		
Module	**Content**	**Hours**
1	Screening of Amylase producing microorganisms from soil.	8
2	Screening of Protease producing microorganisms from soil.	8
3	Screening of antibiotic producing microorganisms from soil.	8
4	Screening of organic acid producing microorganisms from soil.	8
5	Effect of various factors on enzyme activity	8
6	Isolation and purification of enzymes from different sources	8
7	Estimation of glucose by enzymatic method	8
8	Determination of specific activity of enzyme	8
9	Database search and ligand interaction study of enzymes	8

Sem-3

Course Code: SSMB8010

Course Name: Bioprocess Technology II

Prerequisite: Nil

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
4	0	0	4	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:
The students will acquire the fundamental knowledge about bioprocess technology, use of microorganisms in industry, various fermentation processes, bioreactors and its applications.
To inculcate habit of scientific reasoning, to do the task rationally.

Course Contents:

Section-I			
Module	**Content**	**Hours**	**Weightage (%)**
1	**Principles of fermentation process:** Introduction to fermentation process; Range and chronological development of fermentation process; Kinetics of batch, fed batch and continuous cultures; types of fermentation: solid state and submerged fermentation.	15	25
2	**Design of bioreactors:** Basic design and significance of various components of bioreactor or bioprocess vessels; specialized materials used to construct bioreactors; types of bioreactors: 1) Continuous stirred tank, 2) Bubble column, 3) Airlift bioreactor, 4) Fluidized bed, 5) Packed bed, 6) Photo-bioreator.	15	25
Section-II			
3	**Typical fermentation process:** Antibiotic fermentation: β-lactam, Tetracyclin, aromatic antibiotics; Vitamins: Vit B12, riboflavin, Vit A; Organic acids: citric acid, lactic acid, acetic acid (vinegar).	15	25
4	**Other fermentation process and single cell protein** Anerobic fermentation: Acetone-butanol-ethanol (ABE), Brewing, Industrial alcohol; Enzyme production: Amylase, protease, pectinase; SCP: Spirulina, Mushroom, advantages and disadvantages of SCPs.	15	25

Reference Books:

Title	Authors	Publisher
Principles of Fermentation Technology	A. Whitekar, P. F. Stanbury& S. J.	Springer Publications

	Hall	
Industrial Microbiology	L. E. Casida	New Age International Publishers
Fermentation Technology	H A Modi	Avishkar Publishers
Industrial Microbiology	A H. Patel	Trinity Publishers
Textbook of Biotechnology	W. Crueger and A. Crueger	NiraliPrakashan

Course Code: SSMB8030

Course Name: Environmental & Agricultural Microbiology

Prerequisite: Nil

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
4	0	0	4	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:
The students will acquire the fundamental and basic knowledge about agriculture and environment friendly microorganisms, microbial degradation, xenobiotics, ecosystem, diversified organisms, various energy cycles, pollutions harming environment, solutions and its applications. The students also acquire knowledge of agriculture, biofertilizers, soil ecosystem, siderophores, plant diseases and solutions.
To inculcate habit of scientific reasoning, to do the task rationally.

Course Contents:

Section-I			
Module	**Content**	**Hours**	**Weightage (%)**
1	**Basic introduction to Environment** • Environment- biotic and abiotic environment, Interactions. Habitat, Niche • Microbial Diversity of Various environments • Ecosystems – Types of Ecosystem, Various Pyramids • Ecological Succession - Types; mechanisms; changes involved in succession and Climax • Ecosystem Ecology: Ecosystem structure & function • Energy flow and mineral cycling (C, N, P); primary production and decomposition • Structure and function of some ecosystems: terrestrial (forest, grassland) and aquatic (fresh water, marine, eustarine) Eutrophication	15	25
2	**Environmental Pollution** • Types of pollution and its measurement • Air pollution and its control • Water pollution and its control. • Measurement of water pollution presence of Sulphates, phosphates, Nitrates, Chlorides, Salts, COD, BOD, sources of water pollution. • Microbiology of water and Public health. Treatment -Physical, chemical and biological treatment processes. • Treatment schemes for various industrial waste waters: Dairy, Distillery, Tannery, Sugar, Antibiotic industry. • Marine water Pollution	15	25

	• Bioaccumulation, Biomagnification		
Section-II			
3	**Plant – Microbe Interactions** • Biofertilizers: Nutrient Management in Plants- N2 Fixing Microorganisms—Rhizobium, Azolla, Azospirillum, Frankia, Azotobacter, • Cyanobacteria, • Mycorrhizae, VAM: production and applications • Phosphate solubilizing microorganisms • Micorbial inoculant development and application of field. Plant growth regulators- Auxins, Gibberellins, Cytokinenes, Ethylene, ABA, Flowering hormones, Miscellenous Natural Substances	15	25
4	**Bio-control of Plant pathogens** • Siderophores - Types, Classification, Effects of Iron on plants, Applications on plants as biocontrol, growth promoter • Microbial -insecticides: Bacillus thuringiensis, Baculoviruses , Agrobacterium tumefaciens • Transgenic Plants – Resistance & Applications • Advantages of Genetically modified Plants • Agricultural Plant Diseases- Blight of Potato, Canker of Leaves, Powdery Mildew, Downy Mildew, Rust, Mosaic	15	25

Reference Books:

Title	Authors	Publisher
Laboratory manual in environmental engineering	P.D.Kulkarni	CRC Press Publishers
Experiments in Microbiology plant pathology	K.R.Aneja	New Age International Publishers
Experimental environmental Microbiology	APPHHA	American Press Publishers
Waste Water Engineering	Metcalf and Eddy	CRC Press
Environmental Microbiology	Ralph Mitchell	Springer Publications
Biotechnology in Crop Improvement	H.S.Chawla.	Kindle Publishers
Agriculture Microbiology	K R Aneja	Kluwer Academic Publishers
Advances in Agriculture Microbiology	N S SubbaRao	Apple Academic Press

Course Code: SSMB8070

Course Name: Medical Microbiology

Prerequisite: Nil

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
4	0	0	4	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:
The students will acquire the fundamental and basic knowledge about pathogenic organisms, microbial infections, nosocomial infections, immune system, functions vaccination, various diseases cycle, signs, symptoms and treatment of various diseases.
To inculcate habit of scientific reasoning, to do the task rationally

Course Contents:

Section-I			
Module	**Content**	**Hours**	**Weightage (%)**
1	**Introduction to Pathology** • Normal Flora of human body • Sources and routes of Transmission of Organisms • Pathogenesis- Invasion, adhesion, host cell damage, release of pathogens • Collection of Sample- Specimen Collection, transport, preservation, preliminary processes of clinical samples • Biomedical Waste Management • Introduction to Hematology- Blood	15	25
2	**Immune System** • Organs & Cells of Immune System • Antigens- Structure, Properties, types and Specificity • Immunoglobulin's –Structure, types ,Properties, Classification • Complement System- Components, Properties, Pathways, Functions • Hypersensitivity- Types, Classification, Reactions • Antigen- Antibody Reactions- Agglutinations, Precipitations, ELISA, Immuno fluoroscens, RIA, applications of these in disease diagnosis • Transplantation Immunity	15	25
Section-II			
3	**Bacterial Diseases**	15	25

	• Characteristics, classification, pathogenesis, pathology, diagnosis, treatment, prevention and control of diseases caused by • Gram positive -*Staphylococci, Streptococci, Bacillus, Clostridium, Corynebacterium, Mycobacteria.* Characteristics, classification, pathogenesis, pathology, diagnosis, treatment, prevention and control of diseases caused by - Gram negative *Escherichia, Salmonella, Shigella, Klebsiella, Proteus, Vibrio, Pseudomonas, Spirochaetes, Rickettsia.*		
4	**Viral and Fungal Diseases** • Pathogenesis, laboratory diagnosis, prevention and treatment of DNA Virus: Structure, multiplication, classification and medical importance of DNA viruses - Hepatitis, Adeno • Pathogenesis, laboratory diagnosis, prevention and treatment of RNA virus: - • Orthomyxo- Parainfluenza Virus • Piornavirus- Polio Virus • Pox Virus- Small Pox Virus • Retro Virus- HIV virus. • Viral vaccines and antiviral agents. • Mycosis- Superficial, Deep Mycoses, Subcutaneous Mycoses, opportunistic mycoses • Human mycotic infections caused by Dermatophytes, Histoplasma, Cryptococcus, Candida • Mycotoxins	15	25

Reference Books:

Title	Authors	Publisher
Mechanism of Microbial Diseases	Chaechter M. Medoff G. and Eisenstein BC	Wiley Blackwell
Medical Microbiology. 14th edition	David Greenwood, Richard CD, Slack, John Forrest Peutherer	Willions and Wilkins Publishers
Pharmaceutical Microbiology	Hugo WB and Russell AD	CBS Publishers and Distributers
Clinical Microbiology	Joan Stokes E, Ridgway GL and Wren MWD Microbiology	CRC Press
Microbiology: Fundamentals and Applications	Ronald M. Atlas	Mc Graw Hills
Principles of Bacteriology, Virology and Immunity, Vol. III	Topley &Wlison's	Syra Woods Publishers
Practical Medical Microbiology	Collee, JG. Duguid JP, Fraser AG, Marimon BP	CBS Publishers and Distributors
Laboratory exercises in Microbiology Harley Prescot Microbiological Applications: A Laboratory Manual in General Microbiology H.J. Benson	Harley Prescot, H.J. Benson	Willey Blackwell

Course Code: SSMB8090

Course Name: Microbial Physiology and Metabolism

Prerequisite: Nil

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
4	0	0	4	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:
The students will acquire the fundamental knowledge about the physiology and metabolism in microorganisms, bacterial growth cycle, factors affecting growth, growth control, basics of metabolism and metabolic pathways unique to microorganisms.
To inculcate habit of scientific reasoning, to do the task rationally

Course Contents:

Section-I			
Module	**Content**	**Hours**	**Weightage (%)**
1	**Microbial growth:** Bacterial cell division, growth cycle, measurements of growth- microscopic count, spectrophotometry, viable count, factors affecting growth- temperature, pH, osmolarity, oxygen and pressure, adaptations to various environmental factors.	15	25
2	**Microbial growth control:** Basic principles- bacteriostatic and bactericidal agents; growth control by heat- D_{10} value and Z-value; mechanical removal methods; physical control methods; chemical control methods; evaluation of effectiveness of antimicrobial agents; biological control of microorganisms.	15	25
Section-II			
3	**Introduction to metabolism:** Principles and concepts of microbial metabolism, ATP as major energy currency of cell; redox reactions of central importance in metabolism; sites of electron transport chain;regulation of metabolism; enzymes vs ribozymes.	15	25
4	**Metabolic pathways:** Metabolic diversity and nutritional types; basics of aerobic respiration, anaerobic respiration and fermentation; glycolysis-EMP pathway, HMP pathway, ED pathway, key regulatory enzymes in each pathway; TCA cycle.	15	25

Reference Books:

Title	Authors	Publisher
Prescott's Microbiology	J. M. Willey, L. M. Sherwood and	McGraw-Hill

	C. L. Woolverton	
Brock Biology of Microorganisms	M. T. Madigan, J. M. Martinko, K. S. Bender, D. H. Buckley and D. A. Stahl	Pearson Education, Inc.
Bacterial Physiology and Metabolism	B. H. Kim and G. M. Gadd	Cambridge University Press
Microbial Physiology	Albert G. Moat, J. W. Foster and M. P. Spector	A John Willey & Sons, Inc.
Microbiology A Laboratory Manual	J. Cappuccino and N. Sherman	Pearson Education, Ltd.
Experimental Biology	R. J. Patel and K. R. Patel	Aditya, Ahmedabad, India.

Course Name: Bioprocess technology& Environment & Agriculture Microbiology Practicals

Course Code: SSMB8050

Prerequisite: Nil

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
0	8	0	8	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:
The students will acquire the fundamental basics and practical knowledge about soil microflora, enzyme production, antibiotic production and various environment related parameters and its applications.
To inculcate habit of scientific reasoning, to do the task rationally

Course Contents:

Section-I		
Module	**Content**	**Hours**
1	Isolation of industrially important microorganisms and Soil Micro flora from different natural sources other than soil	12
2.	Isolation of pectinase enzyme producing bacteria from decaying fruits/vegetables	12
3.	Production and estimation of cellulase enzyme by submerged fermentation	12
4.	Production and estimation of amylase	12
5.	Production, and estimation of citric acid	12
6.	Recovery of citric acid	12
7.	Production and estimation of ethanol by yeast using solid state and submerged fermentation	12
8.	Penicillin production and Bioassay	12
9.	Detection of BOD, COD from waste water sample	12
10.	Determination of TS, TDS, TSS from water sample	12
11	Isolation of Symbiotic and Non symbiotic N2 Fixing bacteria from soil sample	**6**
12.	Isolation of pathogenic organisms from various crop plants	**6**
13.	Detection of Chloride from waste water sample	**6**
14.	Detection of Nitrates and Nitrites from waste water sample	**6**
15.	Detection of Sulphates from waste water Sample	**6**

Course Name: Medical Microbiology& Microbial physiology and Metabolism Practical

Course Code: SSMB8110

Prerequisite: Nil

Teaching and Examination Scheme:

Teaching Scheme (Hours/Week)				Examination Scheme (Marks)		
Theory	Practical	Tutorial	Credit	CE	ESE	Total
0	8	0	8	40	60	100

CE: Continuous Evaluation, ESE: End Semester Examination

Objective(s) of the Course:
The students will acquire the fundamental basics and practical knowledge about pathogens, blood grouping, HB, effect of various parameters on microbial growth and its practical applications.
To inculcate habit of scientific reasoning, to do the task rationally.

Course Contents:

Section-I		
Module	**Content**	**Hours**
1	Isolation of pathogenic organisms from various medical samples like Blood, Sputum, Urine	**6**
2.	Blood grouping and Hemoglobin Test	**6**
3.	RPR and Widal Test	**6**
4.	Isolation and Identification of Microbes by Differential and Selective Media and Specialized Staining Techniques- Acid Fast Staining, WB Media, Blood Agar Media, Spirochete Staining, EMB Media, Grams Staining	**6**
5.	Identification of Microbes by Biochemical Tests.	**6**
6	Isolation and identification of fungi from various human mycotic infections	**6**
7	Isolation of *Mycobacterium tuberculosis* from sputum of TB pateint	**6**
8	Study of Total Blood count	**6**
9	Study of differential Count	**6**
10	Study of Various human cells	**6**
11	To study effect of temperature on bacterial growth.	12
12.	To study effect of pH on bacterial growth.	12
13.	To determine the D- value of given bacterial culture.	10
14.	To determine the Z- value of given bacterial culture.	10
15.	To determine UV survival curve of given bacterial sample.	10
16.	To determine minimal inhibitory concentration (MIC) of given antimicrobial agent.	10
17.	To estimate phenol coefficient of given sample.	10
18.	Cultivation of anaerobic bacteria from soil sample.	12
19.	To study catalase and oxidase activity in given bacterial culture.	10
20.	To determine oxygen requirement of microorganisms	12
21.	To study microbial activity in Winogradsky column.	12

Sem-4

SEMESTER – IV

SSMB 8020: DISSERTATION

Project work and Dissertation must be based on Applications of Microbes in, Food and Dairy industry, Pharmaceuticals & Biotechnology Industry and in Diagnostic services.

Semester IV students will be on Industrial Training at Industry / Research Institution /Department during entire term for Project Work and Dissertation.

The Students have to devote 6 days, 8 hours per day at the work place that may be an Institute, Industry, Department and Hospital Laboratory. The Students will have to undergo continuous interaction and one evaluation of progress by a team of Departmental experts. A student who has undergone such evaluations only will be entitled to present his complete project work to the University for Exam.

The University End Term Practical Examination will be carrying 300 marks divided as underneath and shall be conducted by One external expert along with an Internal:

Thesis Content and Applicability: 100 marks

Thesis Write up &Presentation: 100 marks

Presentation on Thesis Work done: 50 marks

Viva Voce on Thesis Work done: 50 marks

The Project work and Dissertation can be made in following Applications:

Food Processing, Beverages, Dairy, Enzymes, Industrial Microbiology, Extremophiles, Pharmaceuticals, Effluent Treatment of Bioremediation, Bioenergy, Analytical Microbiology, Clinical / Medical Microbiology and Diagnostics, Biofertilizers& Biopesticides

SSMB 8040-

Review Article Writing

SSMB 8080

Research Paper Presentation