L INSTRUCTIONS

AND

COURSE CURRICUL UM

FOR

M. Sc. MICROBIOLOGY

Effective from July 2009

DEPARTMENT OF BIOTECHNOLOGY
HIMACHAL PRADESH UNIVERSITY
SUMMER HILL, SHIMLA-171005

ENT OF BIOTECHNOLOGY
L PRADESH UNIVERSITY
SUMMER-HILL, SHIMLA-171005

M.Sc. MICROBIOLOGY PROGRAMME

GENERAL INSTRUCTIONS/GUIDELINES FOR EXECUTION OF CURRICULUM

1. The M.Sc. Microbiology programme will be of two years duration spread over four semesters
2. There will be sixteen courses for M.Sc. Microbiology programme. In the first, second and third semester, there will be five courses. However, in fourth semester there will be only research project work. In each semester (excluding fourth semester) there will be one elective course and two laboratory courses. Course No. 401 will consist of research project report only.
3. The distribution of marks in each course for theory, practical and internal assessment will be as per details given in the OUTLINES OF COURSES FOR M. Sc. MICROBIOLOGY
4. The split for internal assessment will be: i) Two internal assessment tests of 7.5 marks in each course. The date of each of these internal assessments for each of the course shall be notified by the Chairman of the Department at the beginning of the semester. The remaining five marks shall be awarded by considering the class attendance record of the students. The criteria to be followed shall be : i) Without condonation of lectures upto 75% 1 mark; 76-80% lectures 2 marks, 81-85% lectures 3 marks; 86-90% lectures, 4 marks; 91% and above lectures 5 marks.
5. For internal assessment, the concerned teacher will examine the students in his/her subject by giving multiple choice questions (MCQ of 0.5 mark each) covering the syllabus/topics taught in the classes. The Coordinator of the programme will notify the date sheet for internal assessment tests at the beginning of semester/academic calendar. In case a student is absent in the internal assessment test, the student will explain in writing the reason for absence to the Coordinator of the programme. Such cases will be discussed in the Departmental Council/Staff Council and if it finds the reason given by the student valid, it will recommend to the Coordinator of the programme to allow the student to sit in such test separately.
6. The candidate who regularly attends teaching/ practical classes and maintains 75% attendance in each of the courses/ practicals shall be permitted to sit in the semester examinations.
7. Any candidate who intends to participate in intra-university or inter-university cultural/ sports/ extracurricular function(s) shall get her/ his name recommended by the Chairperson/ Coordinator Microbiology Programme for being considered for any such participation(s) and benefit(s) if any, thereof.
8. The project work will be in the specialized area of the Microbiology. The project work will start from the third semester. The students will submit the project report by the due date as fixed by the Examination Branch. The Departmental Council will evaluate these. There will be a viva-voce examination on the project report by the Departmental Council. If the Coordinator of the programme feels, he may invite an External Expert for evaluation of the Project Reports. The evaluation of the Project Report and Seminar will be of 200 and 100 marks, respectively.
9. The admission to M.Sc. Microbiology programme of Himachal Pradesh University at campus as well as admission to M.Sc. Microbiology programme offered by institutions affiliated to Himachal Pradesh University will be through a Combined

nducted by Himachal Pradesh University Shimla or as esh University from time to time.

Eligibility for admission will be Bachelor Degree under 10+2+3 pattern of Education in Sciences with any of the subjects *i.e.* Microbiology, Biochemistry, Biotechnology, Genetics and Molecular Biology, Botany or Zoology or MBBS/ B.V.Sc from any Institute/ University recognized by the Himachal Pradesh University, Shimla/ University Grant Commission, New Delhi with at least 50% marks OR a Degree of a University recognized as equivalent by the Vice-Chancellor for the purpose.

- The tuition fee and other monthly/annual charges will be as per University rules.

URSES FOR M. Sc. MICROBIOLOGY

Course No.	Title of course	Marks			Total Marks
		Theory	Practical	Internal assessment	
Semester I					
101	Bacteriology	80	-	20	100
102	Virology	80	-	20	100
103	Mycology & Phycology	80	-	20	100
104	Biochemistry	80	-	20	100
105	Immunology	80	-	20	100
P-101	General Microbiology	-	80	20	100
P-102	Biochemical & Biophysical Techniques	-	80	20	100
Total Marks in Semester I		**400**	**160**	**140**	**700**
Semester II					
201	Molecular Biology & Microbial Genetics	80	-	20	100
202	Recombinant DNA Technology	80	-	20	100
203	Infection & Immunity	80	-	20	100
204	Medical Microbiology	80	-	20	100
205	Biostatistics	80	-	20	100
P-201	Molecular Biology & Recombinant DNA Technology	-	80	20	100
P-202	Diagnostic Microbiology & Immunology	-	80	20	100
Total Marks in Semester II		**400**	**160**	**140**	**700**
Semester III					
301	Environmental Microbiology	80	-	20	100
302	Food Microbiology	80	-	20	100
303	Industrial Microbiology	80	-	20	100
304	Computers & Bioinformatics	80	-	20	100
P-301	Applied Microbiology I	-	80	20	100
P-302	Applied Microbiology II	-	80	20	100
Elective (any one)		80	-	20	100
EL-301	Metabolic Engineering				
EL-302	Microbial Enzymes				
EL-303	Microbial Genomics & Proteomics				
Total Marks in Semester III		**400**	**160**	**140**	**700**
Semester IV					
401	Research Project Report	-	-	200*	200
P-401	Seminar and Viva-Voce	-	-	100*	100
Total Marks in Semester IV		**-**	**-**	**300**	**300**
Grand Total (Semester I-IV)		**1200**	**480**	**720**	**2400**

***** The Departmental Council will evaluate the research project report and will conduct viva-voce examination of the students.

Department of Biotechnology
Himachal Pradesh University
Summerhill, Shimla - 171 005 (H.P.) India

SYLLABUS FOR M.SC. MICROBIOLOGY

COURSE 101 : BACTERIOLOGY

Maximum Marks - 80 **Teaching Hours - 45**

Note : Examiner will set 09 (nine) questions covering all topics/sections of the syllabus and at least one question from each section Out of the nine questions, there will be an objective type question covering entire syllabus which will be compulsory. The students will attempt five questions including the compulsory questions. All questions will carry equal marks.

Unit 1

Morphology and ultra structure of bacteria ï morphological types ï cell walls of archaebacteria ï gram negative ï gram positive eubacteria, L-forms ï cell wall synthesis, antigenic properties ï capsule ï types, composition and function, cell membranes ï structure ï composition ï properties.

Unit 2

Structure function of flagella ï cilia ï pilli ï gas vesicles ï chromosomes, carboxysomes ï magnetosomes and phycobolisomes ï nucleoid ï cell division ï spores, Reserve food materials ï polyhydroxybutyrate ï polyphosphate granules ï oil droplets ï cyanophycin granules and sulphur inclusions.

Unit 3

Brief account of photosynthetic and accessory pigments ï chlorophyll ï bacteriochlorophyll ï rhodopsin ï carotenoids ï phycobilliproteins; Carbohydrates ï anabolism ï autotrophy ï oxygenic ï anoxygenic photosynthesis ï autotrophic generation of ATP; fixation of CO_2 ï Calvin cycle ï C3 ï C4 pathway. Chemolithotrophy ï sulphur ï iron ï hydrogen ï nitrogen oxidations, methanogenesis ï luminescence.

Unit 4

Cultivation of bacteria - cell division ï aerobic ï anaerobic ï shaker ï still ï nutritional types ï culture media used ï growth curve ï generation time ï asynchronous ï synchronous culture ï measurement of growth, control of bacteria ï physical and chemical agents ï preservation methods, Endospore ï structure ï properties ï germination, sporulation and morphogenesis, Dormancy.

Unit 5

Classification of micro organisms ï introduction ï Haeckelôs three kingdom concept ï Whittakerôs five kingdom concept ï three domain concept of Carl Woese, Basis of microbial classification, Classification and salient features of bacteria according to the Bergeyôs manual of determinative bacteriology, cyanobacteria, prochlorons and cyanelles.

Books:

1. Bergeyôs Manual of Systematic Bacteriology ï P.H.A Sneath, N.S Mair, M. Elizabeth.
2. Stryer L. Biochemistry W.H. Freeman Company, New York
3. Stainer R Y, Ingharam JL, Wheelis ML, Painter PR General Microbiolgy, Macmillan Educational Ltd.
4. A.J. Salle, Fundamental Principles of Bacteriology.
5. Brock T.D, Madigan M.T, Biology of Microorganisms. Prentice Hall Int. Inc.
6. Pelczar M.J, Chan E.C.S, Kreig N.R. Microbiolgy, Mc Graw Hill.

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SYLLABUS FOR M.SC. MICROBIOLOGY

COURSE 102 : VIROLOGY

Maximum Marks - 80 **Teaching Hours - 45**

Note : Examiner will set 09 (nine) questions covering all topics/sections of the syllabus and at least one question from each section Out of the nine questions, there will be an objective type question covering entire syllabus which will be compulsory. The students will attempt five questions including the compulsory questions. All questions will carry equal marks.

Unit 1: General Virology

Brief outline on discovery of viruses, nomenclature and classification of viruses; distinctive properties of viruses; morphology and ultrastructure; capsids and their arrangements; types of envelopes and their composition-viral genome, their types and structures; virus related agents (viroids, prions).

Unit 2: General Methods of Diagnosis and Serology

Cultivation of viruses in embryonated eggs, experimental animals, and cell cultures; primary and secondary cell cultures; suspension cell cultures and monolayer cell cultures; cell strains, cell lines and transgenic systems; serological methods ï haemagglutination and HAI; complement fixation; immunofluorescence methods, ELISA and Radioimmunoassays; assay of viruses ï physical and chemical methods (protein, nucleic acid, radioactivity tracers, electron microscopy) ï Infectivity assay (plaque method, end point method) ï Infectivity assay of plant viruses.

Unit 3: Bacterial Viruses

Bacteriophage structural organization; life cycle; one step growth curve; transcription; DNA replication; eclipse phase; production; burst size; lysogenic cycle; bacteriophage typing; application in bacterial genetics; brief details on M13, Mu, T3, T4 and Lambda P1.

Unit 4: Plant Viruses

Classification and nomenclature; effects of viruses on plants; appearance of plants; histology, physiology and cytology of plants; common virus diseases of plants; paddy, cotton, tomato and sugarcane; viruses of cyanobacteria, algae, fungi, life cycle; type species of plant viruses like TMV, Cauliflower Mosaic Virus and Potato Virus X; transmission of plant viruses with vectors (insects, nematodes, fungi) and without vectors (contact, seed and pollens); diagnostic techniques in seeds; seed stocks and diseased plants (seed morphology, seedling symptomatology, indicator plants, serological methods, histochemical tests and fluorescent microscopy); prevention of crop loss due to virus infection ï virus- free planting material; vector control.

of animal human viruses; epidemiology, lifecycle, pathogenicity, diagnosis, prevention and treatment of RNA virurses Picorna, Ortho myxo, Paramyxo, Toga and other arthropod viruses, Rhabdo, Rota, HIV and other Oncogenic viruses; DNA viruses; Pox, Herpes, Adeno, SV 40; Hepatitis 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.

Books:

1. Morag C and Timbury M.C: Medical virology X Edition. Churchill Livingstone, London.
2. Dimmock NJ, Primrose SB: Introduction to Modern Virology, Blackwell Scientific Publications, Oxford.
3. Conrat HF, Kimbell PC and Levy JA: Virology-III Edition Prentice Hall, Englewood cliff, New Jersey.
4. Mathews, RE: Functional of plant virology, Academic press, San Diego.
5. Lennetter, EH: Diagnostic procedures for Viral and Rickettsial diseases. American Public Health Association, NY.

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SYLLABUS FOR M.SC. MICROBIOLOGY

COURSE 103 : MYCOLOGY & PHYCOLOGY

Maximum Marks - 80 **Teaching Hours - 45**

Note : Examiner will set 09 (nine) questions covering all topics/sections of the syllabus and at least one question from each section Out of the nine questions, there will be an objective type question covering entire syllabus which will be compulsory. The students will attempt five questions including the compulsory questions. All questions will carry equal marks.

Unit 1

Historical introduction to mycology structure and cell differentiation. General features of fungi, Classification of fungi, life cycle of selected fungi (Aspergillus, Penicillium, Yeasts). Hyphae and non-motile unicells, motile cells, spores, dormancy, growth of population and colonies, Division myxomycota, Acrasiomycetes, hydroxymycetes, myxomycetes, Plasma-diophoromycetes. Zoosporic fungi- Chytridiomycetes, Hypochytridiomycetes, oomycetes. Zygomycotina ï Zygomycetes, Trichomycetes ï Evalutionary tandencies in lower fungi.

Unit 2

Ascomyctina ï Hemiascomycetes, plectomycete, pyrenomycetes, Discomycetes, laboulberiomycetes, oculoascomycetes. Basidiomycotina teliomycetes, hymenomycetes, Deuteromycotina ï hypomycetes, coelomycetes, blastomycetes.

Unit 3

Heterothallism, sex hormones in fungi. Physiological specialization phylogeny of fungi, Lichens ï ascolichens, basidiolichens, deuterolichens. Mycorrhiza ï ectomycorrhiza, endomycorrhiza, vesicular arbuscular mycorrhiza. Fungi as insect symbiont, fungal diseases ï mycoses systemic and subcutaneous, candidiasis, Pneumocystis, blastomyxoses, dermotophytosis.

Unit 4

Fungi and ecosystem: effect of environment on growth, prevention of fungal growth. saprophytes, substrate groups and nutritional strategies substrate successions, fungi and bioremediation, parasitism, mutualism and symbiosis with plants and animals, attack on fungi by other microorganisms.

Unit 5

Distribution of algae, classification of algae, algal nutrition, algal thallus, algal reproduction, green algae, diatoms, euglenoids, brown Rhodophyta, pyrrophyta, Algal ecology and algal biotechnology.

Books:

1. Mehrotra, R.S. and K.R. Aneja: An introduction to Mycology. New Age International publishers.
2. Alexopoulos, C.J. and C.W. Mims: Introduction to Mycology. Wiley Eastern Ltd, New Delhi.
3. Fundamentals of Mycology, J.H. Burnett, Publisher: Edward.
4. The Fungi. M. Charlile and S.C. Watkinson, Publisher: Academic Press.
5. Fundamentals of the fungi. E Moore ï Landeekeer, Publisher: Prentice Hall

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SYLLABUS FOR M.SC. MICROBIOLOGY

COURSE 104 : BIOCHEMISTRY

Maximum Marks - 80 **Teaching Hours - 45**

Note : Examiner will set 09 (nine) questions covering all topics/sections of the syllabus and at least one question from each section Out of the nine questions, there will be an objective type question covering entire syllabus which will be compulsory. The students will attempt five questions including the compulsory questions. All questions will carry equal marks.

Unit 1

Composition of living matter, biochemistry of bacterial, animal and plant cell, specialized components of microorganisms and their structure and function.

Unit 2

Enzymes as biocatalysts, enzyme classification, specificity, active site, activity unit, isozymes. Enzyme kinetics: Michaelisï Menton equation for simple enzymes, determination of kinetic parameters, multistep reactions and rate limiting steps, enzyme inhibition, allosterism, kinetic analysis of allosteric enzymes, principles of allosteric regulation.

Unit 3

Structural features and chemistry of macromolecules; nucleic acid, proteins, carbohydrates and lipids and biomolecules such as antibiotics, pigments and other secondary metabolites.

Unit 4

Bioenergetics and strategy of metabolism: flow of energy through biosphere, strategy of energy production in the cell, oxidation reduction reactions, coupled reactions and group transfer, ATP production, structural features of biomembranes, transport, free energy and spontaneity of reaction, G, G^0, Gôand equilibrium, basic concepts of acids, base, pH and buffers.

Unit 5

Cell metabolism: catabolic principles and break down of carbohydrates, lipids, proteins and nucleic acids, biosynthesis of macromolecules, hormone regulation of metabolism, vitamins and their role as coenzymes.

Books:

1. Biochemistry, Stryer edition W.H. Freeman.
2. Principles of Biochemistry, Lehninger, by Nelson and Cox.

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COURSE 105 : IMMUNOLOGY

Maximum Marks - 80 **Teaching Hours - 45**

Note : Examiner will set 09 (nine) questions covering all topics/sections of the syllabus and at least one question from each section Out of the nine questions, there will be an objective type question covering entire syllabus which will be compulsory. The students will attempt five questions including the compulsory questions. All questions will carry equal marks.

Unit 1: Immune System

History of immunology, cells and tissues involved in immune system; virulence and host resistance; immune responses ï innate immunity, acquired immunity; immuno-hematology ï blood groups, blood transfusion and Rh-incompatibilities.

Unit 2: Antigens and Antibodies

Antigens structure and properties, types, iso- and alloantigens, haptens; adjuvants, antigen processing and specificity; lymphokines; immunoglobulins structure, heterogeneity, types and sub-types, properties (physico-chemical and biological); theories of antibody formation; monoclonal antibodies and their applications.

Unit 3: Antigen-antibody reactions

In-vitro methods: agglutination, precipitation, complement fixation, immuno-fluorescence, ELISA, radio-immuno assay, immuno-histochemical staining; *in vivo* methods: skin tests and immune complex demonstration; applications of these methods in diagnosis of microbial diseases.

Unit 4: Complement

Complement components, pathways and complement deficiencies.

Unit 5: Hypersensitivity

Immediate and delayed; antibody mediated Type-I anaphylaxis, Type-II Antibody dependent cell cytotoxicity, Type-III immune-complex mediated reactions and Type-IV cell mediated hypersensitivity reactions; respective diseases, immunological methods of their diagnosis.

Books:

1. Immunology - **Janis Kuby**
2. Essentials of Immunology (6th Edition)- **Ivan Roitt**
3. Cellular and Molecular Immunology - **Abul K. Abbas, Andrew H. Lichtman and Jordan S**
4. Immunology: An Introduction - **Ian R. Tizard**
5. Fundamentals of Immunology ï **William E. Paul**, Raven Press.

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SYLLABUS FOR M.SC. MICROBIOLOGY

COURSE P-101 : GENERAL MICROBIOLOGY
Total Marks – 100 (Practical examination-80, Internal assessment-20)

(I) Microscopy ï Microscope and its operations ï components ï Microscope adjustments ï Light sources ï microscopic measurements ï calibration: Types of microscope available ï theory. Observation of various types of microbes under phase contrast, dark field and fluorescence.
(II) Preparation of glassware ï washing ï sterilization techniques ï wet heat ï dry heat ï filter types ï laminar flow chamber types ï CDC ï safety levels.
(III) Preparation of culture media ï nutritional needs of microbes ï dehydrated ï selective ï differential ï autotrophic ï heterotrophic. Culture techniques ï adjustment of pH ï buffers ï pure culture techniques ï preparation of slants. Subculturing.
(IV) Isolation and identification of bacteria and fungi.
(V) Microbial growth measurements ï cell count ï turbidity measurements ï percentage transmission, Optical density ï serial dilution ï standard plate count.
(VI) Morphological, nutritional and cultural characteristics of bacteria and identification of microbes: types of dyes ï preparation ï staining techniques ï Gram ï capsule ï negative ï flagella, spore and nuclear.

References:

1. Experimental Microbiology Laboratory guide, Robert C. Cross, Kalyani Publishers, Ludhiana.
2. Microbiology ï A Laboratory manual ï J.G. Cappucino, N. Sherman.

COURSE P-102 : BIOCHEMICAL & BIOPHYSICAL TECHNIQUES
Total Marks – 100 (Practical examination-80, Internal assessment-20)

(I) Measurement: criteria of reliabiligy, precision, accuracy, sensitivity, specificity.
(II) Laboratory rules and safety regulations, first aid.
(III) Principles of colorimetry: verification of Beerôs law, estimation of a selected protein, finding out lmax, relation between O.D. and percentage transmission. Isolation and quantification of DNA from microorganisms or other sources.
(IV) pH, pK, Henderson-Heasselbach equation, preparation of buffers.
(V) Separation of amino acids by paper chromatography.
(VI) Isolation of phospholipids from liver and their separation by thin layer chromatography.
(VII) Separation of haemoglobin and blue dextran by gel filtration.
(VIII) Ion exchange chromatography: CM cellulose and DEAE cellulose.
(IX) Cell fractionation into nuclear, mitochondrial and cytoplasmic fraction; estimation of marker enzymes.
(X) Factors affecting enzyme activity: temperature, substrate, concentration and pH using any stable enzyme and kinetics of enzyme activity.
(XI) Study of isoenzymes of lactate dehydrogenase by PAGE
(XII) Various Agglutination reactions: Widal, Haemagglutination etc.

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SYLLABUS FOR M.SC. MICROBIOLOGY

COURSE 201 : MOLECULAR BIOLOGY & MICROBIAL GENETICS

Maximum Marks - 80 **Teaching Hours - 45**

Note : Examiner will set 09 (nine) questions covering all topics/sections of the syllabus and at least one question from each section Out of the nine questions, there will be an objective type question covering entire syllabus which will be compulsory. The students will attempt five questions including the compulsory questions. All questions will carry equal marks.

Unit 1

Nucleic acids as genetic information carriers: experimental evidence, DNA structure: historical aspects and current concepts, melting of DNA. DNA replication: general principles, various modes of replication, isolation and properties of DNA polymerases, proof reading, continuous and discontinuous synthesis. Asymmetric and dimeric nature of DNA polymerase, exonuclease activity in eukaryotic DNA polymerases. Superhelicity in DNA, linking number, topological properties, mechanism of action of topoisomerases.

Unit 2

Initiation of replication of single stranded DNA. Construction of replication fork in test tube. Retroviruses and their unique mode of DNA synthesis. Relationship between replication and cell cycle. Inhibitors of DNA replication (blocking precursor synthesis, nucleotide polymerization, altering DNA structure). DNA damage and repair: types of DNA damage (deamination, oxidative damage, alkylation, pyrimidine dimers). Repair pathways ï methyl-directed mismatch repair, very short patch repair, nucleotide excision repair, base excision repair, recombination repair, SOS system.

Unit 3

Structural features of RNA (rRNA, tRNA and mRNA) and relation to function. Initiator and elongator class of tRNA, ribosome binding site on mRNA and corresponding site on rRNA, peptidyl transferase activity of 23S rRNA. Transcription: general principles, basic apparatus, types of RNA polymerases, steps: initiation, elongation and termination, inhibitors of RNA synthesis. Polycistronc and monocistronic RNAs. Control of transcription by interaction between RNA polymerases and promoter regions, use of alternate sigma factors, controlled termination: attenuation and antitermination.

Unit 4

Regulation of gene expression: operon concept, catabolite repression, instability of bacterial RNA, positive and negative regulation, inducers and corepressors. Negative regulation ï *E. coli* lac operon; positive regulation ï *E. coli* ara operon; regulation by attenuation ï his and trp operons; antitermination ï N protein and nut sites in I. DNA binding proteins, enhancer sequences and control of transcription. Identification of protein ï binding sites on DNA. Global regulatory responses: heat shock response, stringent response and regulation by small molecules such as ppGpp and cAMP, regulation of rRNA and tRNA synthesis.

RNA: methylation, cutting and trimming of rRNA; cing of mRNA; cutting and modification of tRNA degradation system. Catalytic RNA, group I and group II intron splicing, RNase P.

Unit 5

Basic features of the genetic code. Protein synthesis: steps, details of initiation, elongation and termination, role of various factors in the above steps, inhibitors of protein synthesis. Synthesis of exported proteins on membrane-bound ribosomes, signal hypothesis. In vitro transcription and translation systems. Microbial genetics and design of vaccines. BCG and design of vaccine for TB and leprosy. DNA vaccines, design and advantages.

Books:

1. Genes VII. Lewin, Oxford University Press.
2. Molecular Cell Biology (W. H Freeman) by Lodish, Berk, Zippursky.

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COURSE 202 : RECOMBINANT DNA TECHNOLOGY

Maximum Marks - 80 **Teaching Hours - 45**

Note : Examiner will set 09 (nine) questions covering all topics/sections of the syllabus and at least one question from each section Out of the nine questions, there will be an objective type question covering entire syllabus which will be compulsory. The students will attempt five questions including the compulsory questions. All questions will carry equal marks.

Unit 1

Gene as unit of mutation and recombination. Molecular nature of mutations; mutagens. Spontaneous mutations ï origin, Core techniques and essential enzyme used in rDNA technology. Restriction digestion, ligation and transformation.

Unit 2

Cloning vectors ï plasmids, phages and cosmids

F- factors description and their uses in genetic analysis. Colicins and col factors. Plasmids as vectors for gene cloning. Replication of selected plasmids: compatibility. Transposons and their uses in genetic analysis.Cloning strategies. Cloning and selection of individual genes, gene libraries: cDNA and genomic libraries, Bacteriopages, Lytic phages ï T7 and T4. Lysogenic phages I and PI. M13 and fX174. Life cycle, and their uses in recombinant DNA technology.

Unit 4

Gene transfer mechanisms ï transformation, transduction, conjugation and transfectin. Mechanisms and applications. Genetic analysis of microbes. Bacteria and yeast. PCR methods and application.

Unit 3

Specialized cloning strategies. Expression vectors, Promoter probe vectors, vectors for library construction ï artificial chromosomes.

Unit 5

DNA sequencing Methods; dideoxy and chemical method. Sequence assembly. Automated sequencing. Genome sequencing and physical mapping of genomes.

Books:

1. Principles of gene manipulation. Old and Primrose. Blackwell Scientific Publications.
2. Molecular cloning. 3 volumes. CSH press.

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SYLLABUS FOR M.SC. MICROBIOLOGY

COURSE 203 : INFECTION & IMMUNITY

Maximum Marks - 80 **Teaching Hours - 45**

Note : Examiner will set 09 (nine) questions covering all topics/sections of the syllabus and at least one question from each section Out of the nine questions, there will be an objective type question covering entire syllabus which will be compulsory. The students will attempt five questions including the compulsory questions. All questions will carry equal marks.

Unit 1: Principles of Medical Microbiology

Classification of medically important microorganisms; Microbial pathogenicity; transmissibility, infectivity and virulence; opportunistic pathogens, true pathogens; toxigenicity, invasiveness, other aggressins (Hyaluronidase), coagulase, fibrolysins or kinase; depolymerizing enzymes (mucinase, lipase, proteases, nucleases, collagenases, neuraminidase); brief account of protozoa (*Entamoeba*, *Giardia*, *Leishmania*, *Trypanosoma*, *Plasmodium* and *Balantidium*) and helminth parasites (*Schistosoma*, *Taenia*, *Echinococcus*, *Ascaris*, *Trichiuris*, *Hookworms* and *Wuchereria*) of man and their diseases.

Unit 2: Vaccines

Immunization, types of vaccines, immunological principles of vaccinations, routes of vaccinations; immunological memory; vaccines in use: Poliomyelitis, BCG, DPT, Bird Flu, Hepatitis-A & B, Rabies virus.

Unit 3: Immuno-parasitology

Immunity to amoebasis, trypanosomiasis, leishmaniasis, malaria, filarasis, hookworm infections and ascariasis

Unit 4: Immunity to viruses

Brief account of viral diseases of man (HERPES, Arbo-viruses, Papova viruses, Influenza virus, Hepatitis A, B & C) virological parameters, spread and transmission; cellular vs humoral immunity to viruses; immunological mechanisms of viral persistence; cancer immunology; immuno-surveillance; immuno-pathology and immune response to HIV.

Unit 5: Immunity to bacteria

Brief account of intra-cellular bacteria and diseases they causes; cell mediated immunity in antibacterial defense; role of cytokines; local immunity; antigens of intra-cellular bacteria; phagocytes and bacterial infections.

Books:

1. Immunology - **Janis Kuby**
2. Essentials of Immunology (6th Edition)- **Ivan Roitt**
3. Cellular and Molecular Immunology - **Abul K. Abbas, Andrew H. Lichtman and Jordan S**
4. Immunology: An Introduction - **Ian R. Tizard**
5. Fundamentals of Immunology ï **William E. Paul**, Raven Press.

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SYLLABUS FOR M.SC. MICROBIOLOGY

COURSE 204 : MEDICAL MICROBIOLOGY

Maximum Marks - 80 **Teaching Hours - 45**

Note : Examiner will set 09 (nine) questions covering all topics/sections of the syllabus and at least one question from each section Out of the nine questions, there will be an objective type question covering entire syllabus which will be compulsory. The students will attempt five questions including the compulsory questions. All questions will carry equal marks.

Unit 1

Early discovery of pathogenic microorganisms, development of bacteriology as scientific discipline; contributions made by eminent scientists. Classification of medically important microorganisms; Normal microbial flora of human body; role of resident flora; normal flora and the human host.

Unit 2

Establishment, spreading, tissue damage and anti-phagocytic factors; mechanism of bacterial adhesion, colonization and invasion of mucous membranes of respiratory, enteric and urogenital tracts. Role of aggressins, depolymerising enzymes, organotropisms, variation and virulence. Organs and cells involved immune system and immune response.

Unit 3

Classification of pathogenic bacteria. *Staphylococcus, Streptococcus, Pneumococcus, Neisseria, Cornebacterium, Bacillus, Clostridium,* Non sporing Anaerobes, Organisms belonging to *Enterobacteriacea*, Vibrios, Non fermenting gram negative bacilli *Yersinia; Haemophilus; Bordetella, Brucella, Mycobacteria, Spirochaetes, Actinomycetes, Rickettsiae, Chlamdiae.*

Unit 4

General properties of Viruses: Viruses host interactions; Pox viruses; Herpes virus, adeno viruses, picarno viruses, orthomyxo viruses, paramyxo viruses, arboviruses, rhabdo viruses, hepatitis viruses; oncogenic viruses; Human immuno deficiency viruses (AIDS). Dermatophytes, dimorphic fungi, opportunistic fungal pathogens. Description and classification of pathogenic fungi and their laboratory diagnosis.

Unit 5

Laboratory control of antimicrobial therapy; various methods of drug susceptibility testing, antibiotic assay in body fluids. Brief account on available vaccines and schedules; passive prophylactic measures; Noscomical infection, common types of hospital infections and their diagnosis and control.

Books:

1. Text of Microbiology: R. Ananthanarayanan and C.K. Jayaram Panicker, Orient Longman.
2. Mackie and McCartney: Medical Microbiology Vol 1: Microbial infection,
   Vol 2: Practical medical microbiology. Churchill Livingstone.

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SYLLABUS FOR M.SC. MICROBIOLOGY

COURSE 205 : BIOSTATISTICS

Maximum Marks - 80 **Teaching Hours - 45**

Note : Examiner will set 09 (nine) questions covering all topics/sections of the syllabus and at least one question from each section Out of the nine questions, there will be an objective type question covering entire syllabus which will be compulsory. The students will attempt five questions including the compulsory questions. All questions will carry equal marks.

Unit I

Principles and practice of statistical methods of biological research, samples and populations; Measures of central tendencies: mean, mode, median and ogives; Measures of dispersion: range, standard deviation and variance **5**

Unit II

Linear correlations: product moment coefficient of correlations, Spearmanôs rank difference correlation methods; Regression analysis: simple regression, regression lines, regression equations, regression equations in case of correlation tables. **4**

Unit III

Probability distribution: addition and multiplication theorems, Bayeôs theorem, Binomial, Poisson, and normal distribution. **3**

Unit IV

Parametric tests: F and T tests, X^2 test, X^2 test as a test of independence and goodness of test, experimental design. **3**

Unit V

Statistical inference: hypothesis testing, significance level, two-tailed and one-tailed tests of hypothesis, Test of significance: concept and basic terminology of large and small sample, means, difference between means. Analysis of variance: assumptions, techniques of analysis of variance and analysis of variance in one-way techniques.

Books:

1. Blisss, C.I.K: Statistics in Biology. Mc Graw Hill, New York.
2. Campbell R.C.: Statistics for Biologists, Cambridge University Press, Cambridge.
3. Lutz, W: Statistical Methods as Applied to Immunological data, In D.M Weir Handbook of Experimental Immunology. Blackwell Publications Ltd. Oxford.

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SYLLABUS FOR M.SC. MICROBIOLOGY

COURSE P-201 : MOLECULAR BIOLOGY AND RECOMBINANT DNA TECHNOLOGY

Total Marks – 100 (Practical examination-80, Internal assessment-20)

(I) Single colony isolation and checking genetic markers.
(II) One step growth curve of bacteriophage T4. Spontaneous and induced mutations ï isolation of antibiotic resistant and auxotrophic mutants.
(III) Selective enrichment of auxotrophic and antibiotic mutants.
(IV) Genetic mapping by conjugation and P1 transduction.
(V) Transposon mutagenesis.
(VI) Gene fusion using bacteriophage Mu.
(VII) Isolation of chromosomal DNA from *E. coli*, Estimation of DNA by spectrophotometry, plasmid DNA isolation and restriction digestion. Agarose gel electrophoresis.
(VIII) DNA cloning using plasmid vectors and in *E. coli* expression vectors.
(IX) Analysis of recombinant proteins using polyacrylamide gel electrophoresis.
(X) Southern and Northern blotting.
(XI) Restriction mapping ï plasmids
(XII) PCR analysis
(XIII) DNA sequencing. Sangerôs method.

Books:

1. Current protocols in molecular biology. Ausbel et al.
2. Molecular cloning Vol 1-III
3. Short course in bacterial genetics. J.H. Miller. CSH Laboratories.
4. Methods for General and molecular bacteriology. Murray et al., ASM Press.

STICS MICROBIOLOGY & IMMUNOLOGY
Total Marks – 100 (Practical examination-80, Internal assessment-20)

(I) Fixation of smears for microscopy by different methods
(II) Different staining techniques

- Simple (Loefferôs polychrome methylene blue and Negative staining)
- Gramôs staining
- Ziehl-Neelson method for AFB
- Fluorochrome staining
- Leishmanôs staining
- Giemsaôs staining
- Special staining methods to demonstrate granules, capsules and spores

(III) Preparation of culture media: Simple tissue culture methods for growing different pathogenic microorganisms
(IV) Conventional and rapid methods of isolation and identification of pathogenic bacteria, fungi.
(V) Anaerobic culture method
(VI) Principles of automated methods for diagnostic microbiology
(VII) Isolation of pure cultures and preservation techniques
(VIII) Drug susceptibility testing by various methods
(IX) Diagnostic immunologic principles and methods

- precipitation method
- Agglutination method
- ELISA method
- Immunodiffusion
- Immunoelectrophoresis
- Widal test
- Haemagglutination

(X) Separation of serum protein by electrophoresis
(XI) Separation and characterization of lymphocytes from blood.
(XII) Demonstration of lymphocyte sub population.

Books:

1. Hudson, L., and Hay, F.C: practical immunology. Blackwell Scientific Publications.

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SYLLABUS FOR M.SC. MICROBIOLOGY

COURSE 301 : ENVIRONMENTAL MICROBIOLOGY

Maximum Marks - 80 **Teaching Hours - 45**

Note : Examiner will set 09 (nine) questions covering all topics/sections of the syllabus and at least one question from each section Out of the nine questions, there will be an objective type question covering entire syllabus which will be compulsory. The students will attempt five questions including the compulsory questions. All questions will carry equal marks.

Unit 1

Aerobiology: Droplet nuclei, aerosol, assessment of air quality, - solid ï liquid ï impingment methods ï Brief account of air borne transmission of microbes ï viruses ï bacteria and fungi, their diseases and preventive measures.

Unit 2

Aquatic microbiology: Water ecosystems ï types ï fresh water (ponds, lakes, streams) ï marine habitats (estuaries, mangroves, deep sea, hydrothermal vents, saltpans, coralreefs). Zonation of water ecosystems ï upwelling ï eutrophication ï food chain. Potability of water ï microbial assessment of water quality ï water purification ï brief account of major water borne diseases and their control measures.

Unit 3

Soil Microbiology: Classification of soils ï physical and chemical characteristics, microflora of various soil types (bacteria and nematodes in relevance to soil types; rhizosphere ï phyllosphere) ï a brief account of microbial interactions symbiosis ï mutualism ï commensalisms ï competition ï amensalism ï synergism ï parasitism ï predation; biogeochemical cycles and the organisms, carbon, nitrogen, phosphorous and sulphur, biofertilizers ï biological nitrogen fixation ï nitrogenase enzyme ï nif genes; symbiotic nitrogen fixation ï (Rhizobium, Frankia) ï nonsymbiotic microbes ï Azotobacter, - Azospirillium ï (vesicular arbuscular mycorrhizae - VAM) - ecto, endo, ectendomycorrhizae ï rumen microbiology.

Unit 4

Waste treatment: Wastes ï types ï solid and liquid wastes characterization ï solid ï liquid; treatments ï physical, chemical, biological ï aerobic ï anaerobic ï primary ï secondary ï tertiary; solid waste treatment ï saccharification ï gasification ï composting, Utilization of solid wastes ï food (SCP, mushroom, yeast): fuel (ethanol, methane) fertilizer (composting), liquid waste treatment ï trickling ï activated sludge ï oxidation pond ï oxidation ditch. Subterranean microbes and bioremediation.

Unit 5

Positive and negative roles of microbes in environment: biodegradation of recalcitrant compounds ï lignin ï pesticides; bioaccumulation of metals and detoxification ï biopesticides; biodeterioration ï of paper ï leather, wood, textiles ï metal corrosion ï mode of deterioration ï organisms involved ï its disadvantages ï mode of prevention. GMO and their impact. Molecular approach to environmental management, Degradative plasmids, Genetic exchange in xenobiotic chemicals.

Books:

1. Alexander, M: Microbial ecology, John Wiley and sons, Inc., New York.
2. Ec Eldowney., S. Hardman, D.J. and Waite, S: Pollution: Ecology and biotreatment ï Longman Scientific Technical.
3. K.C. Marshall: Advances in microbial ecology.

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SYLLABUS FOR M.SC. MICROBIOLOGY

COURSE 302 : FOOD MICROBIOLOGY

Maximum Marks - 80 **Teaching Hours - 45**

Note : Examiner will set 09 (nine) questions covering all topics/sections of the syllabus and at least one question from each section Out of the nine questions, there will be an objective type question covering entire syllabus which will be compulsory. The students will attempt five questions including the compulsory questions. All questions will carry equal marks.

Unit 1

Food as substrate for microorganisms: Micro organisms important in food microbiology ï Molds, Yeasts and Bacteria ï General characteristics ï classification and importance. Principles of food preservation. Asepsis ï Removal of microorganisms, (anaerobic conditions, high temperatures, low temperatures, drying). Factors influencing microbial growth in food ï Extrinsic and intrinsic factors; Chemical preservatives and Food additives. Canning, processing for heat treatment ï D, Z and F values and working out treatment parameters.

Unit 2

Contamination and spoilage: Cereals, sugar products, vegetables, fruits, meat and meat products, Milk and Milk products ï Fish and sea foods ï poultry ï spoilage of canned foods. Detection of spoilage and characterization.

Unit 3

Food-borne infections and intoxications: Bacterial and nonbacterial ï with examples of infective and toxic types ï *Brucella, Bacillus, Clostridium, Escherichia, Salmonella, Shigella, Staphylococcus, Vibrio, Yersinia,* Nematodes, protozoa, algae, fungi and viruses. Foodborne outbreaks laboratory testing procedures; Preventiion measures ï Food sanitation in manufacture and retail trade; Food control agencies and its regulations, Plant sanitation ï Employeeôs health standards ï waste treatment ï disposal ï quality control.

Unit 4

Food fermentatios: bread, cheese, vinegar, fermented vegetables, fermented dairy products; Experimental and Industrial production methods. Spoilage and defects of fermented dairy products ï oriental fermented foods, their quality standards and control.

Unit 5

Food produced by Microbes: Fermented foods, microbial cells as food (single cell proteins) ï mushroom cultivation. Bioconversions ï Production of alcohol ï fermented beverages ï beer and wine. Steroid conversion ï Industrial enzymes production ï amylases, proteinases, cellulases; Amino acid production ï glutamic acid and lysine productions. Genetically modified foods.

Books:

1. Adams M.R and Moss M.O: Food microbiology: Royal society of chemistry.
2. Stanbury, P.F, Whitekar, A and Hall, S.J: Principles of fermentation technology, Pergamon Press.
3. Banwart, G.J: Basic Food Microbiology. CBS Publishers.

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SYLLABUS FOR M.SC. MICROBIOLOGY

COURSE 303 : INDUSTRIAL MICROBIOLOGY

Maximum Marks - 80 **Teaching Hours - 45**

Note : Examiner will set 09 (nine) questions covering all topics/sections of the syllabus and at least one question from each section Out of the nine questions, there will be an objective type question covering entire syllabus which will be compulsory. The students will attempt five questions including the compulsory questions. All questions will carry equal marks.

Unit 1

Biotechnological innovations in the chemical industry, biocatalyst in organic chemical synthesis, efficiency of growth and product formation, microbial growth kinetics, measurement of growth (cell number, direct and indirect methods), growth and product formation, effect of environment (temperature, pH, high nutrient concentration),growth stoichiometry, maintenance energy requirement and maximum biomass, yield, P/O quotients, metabolite overproduction and growth efficiency.

Unit 2

Media formulation. Sterilization, kinetics of thermal death of microorganisms, batch and continuous sterilization. Shake flask, stirred tank airlift fermenter, fed batch continuous and immobilized cell reactor.

Unit 3

Aeration and agitation, power requirement, oxygen transfer kinetics, concepts of Newtonian and Non-Newtonian fluids, plastic fluid apparent viscosity, foam and antifoam.Large scale production.

Unit 4

Metabolic pathways and metabolic control mechanism, industrial production of citric acid, enzymes, ethanol, acetic acid, production and diversification of antibodies. Biofertilizers, biopesticides, mushroom production, fermented food/beverages, Biopolymers.

Unit 5

Industrial strains. Strategies for selection, improvement & maintenance, large-scale production using recombinant microorganisms. Scale-up, instrumentation control, physical and chemical environment sensors, downstream processing.

Books:

1. Biotechnological innovations in chemical synthesis. BIOTOL. Publisher.
2. Industrial microbiology, G. Reed, CBS Publishers.
3. Biology of Industrial microorganisms. A. L. Demain.
4. Stanbury P.F.A. Whitaker and Hall. Principles of fermentation technology.
5. Fermentation: A practical approach. IRL.

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SYLLABUS FOR M.SC. MICROBIOLOGY

COURSE 304 : COMPUTERS AND BIOINFROMATICS

Maximum Marks - 80 **Teaching Hours - 45**

Note : Examiner will set 09 (nine) questions covering all topics/sections of the syllabus and at least one question from each section Out of the nine questions, there will be an objective type question covering entire syllabus which will be compulsory. The students will attempt five questions including the compulsory questions. All questions will carry equal marks.

Unit 1

Computer basics. Operating systems: Windows and Unix. Hardware, software, disk operating system, multimedia network concepts. C-programming; object oriented programming.

Unit II

Word processing using MS-Word, formatting the document, tables, mail merge and spell check. Spreadsheets basics with MS Excel, labels, numerical and formula entries, basic mathematical and statistical functions, graphical representation of data

Unit III

Introduction to data structures and database concepts. Basics of Microsoft Access: Databox wizard, creating fields, properties and tables, datanet records, sorting, queries, forms and records.

Unit IV

Introduction to internet use and search engines: www, HTML, URLs, browsers: Netscape (opera) Explorer, Search engines: Google, PubMED, Sequence information sources (Structure and use on web): EMBL, GENBANK, Entrez, Unigene. Protein information sources (Structure and use on web): PDB, Swissprot, TrEMBL

Unit V

Sequence and phylogeny analysis: Detection of open reading frames (ORFs), gene identification and prediction, method of gene family identification, outline of sequence assembly, mutation matrices, pair wise alignments, introduction to BLAST (using it on web and interpreting results), multiple sequence alignment, phylogenetic analysis. Molecular modeling: introduction, dynamic simulation, conformational search, molecular modeling packages (Chem3D, Hyperchem), protein modeling, structure prediction and molecular docking.

Books:

1)Bioinformatics: Methods and Applications Genimics Proteomics and Drug Discovery, S C Rastogi, N Mendiratta, P. Rastogi, Prentice Hall of India Private Ltd
2)Bioinformatics: The Machine Learning Approach Pierre Baldi and Soren Brunak, MIT Press
3)Bioinformatics: A practical guide to the analysis of genes and proteins, Ed. By Baxvains
4)Bioinformatics online (Methods in Enzymology V. 266 computer method for macromolecular sequence), Ed. By Doolittle, Academic Press
5)Molecular Evolution: a phylogenetic approach, ROM and Holmas EC, Blackwell science
6)Bioinformatics: Sequences, structure and databanks, Des Higgins and Willie Taylor, Oxford University Press

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SYLLABUS FOR M.SC. MICROBIOLOGY

COURSE P-301 : APPLIED MICROBILOGY I

Total Marks – 100 (Practical examination-80, Internal assessment-20)

(I) Basic Design of a Laboratory Fermenter
(II) Cleaning and sterilization of Fermenter Vessel.
(III) Determination of Viability of Cells in a Yeast Culture by Methylene Blue Staining, Plate Count and Haemocytometer Methods
(IV) Determination Growth Curve in a Batch Culture.
(V) Microbial Growth kinetics-Determination of specific growth rate (μ_{max}), saturation constant (K_S) and growth yield ($Y_{X/S}$) for *Saccharomyces cerevisiae* in batch culture.
(VI) Concentration of protein by ultrafiltration.
(VII) Determination of K_La by sulphite oxidation method.
(VIII) Determination of K_La in a bioreactor by dynamic method.
(IX) Determination of thermal death rate constant and decimal reduction time for *E. coli*.
(X) Disruption of microbial cells (Baker's yeast) for the release of the intracellular protein.
(XI) Bio-transformation of sucrose into high fructose syrup by immobilized cell of *Saccharomyces cerevisiae*
(XII) Production of Ethanol by simple/complex carbohydrate sources (media) using *Sachharomyces cerevisiae.*
(XIII) Production of Wine from Apple / Grape Juices by *Sachharomyces cerevisiae.*
(XIV) Production of Citric acid by solid-state-fermentation using *Aspergillus niger.*
(XV) Detection of nicotinic acid by bioassay
(XVI) Detection of number of bacteria in milk by standard plate count (SPC).
(XVII) Determination of quality of milk sample by methylene blue reduction test
(XVIII) Microbiological assay of toxins
(XIX) Role of yeast in bread making

: APPLIED MICROBILOGY II

Total Marks = 100 (Practical examination-80, Internal assessment-20)

(I) Estimation of total solids in sewage samples.
(II) Estimation of volatile matter and fixed residues in sewage samples.
(III) Rapid detection of bacteriological quality of water with special reference to feacal Coliform.
(IV) Determination of dissolved oxygen in waste water samples.
(V) Determination of BOD of waste water samples.
(VI) Determination of COD of waste water samples.
(VII) Determination of rate of decomposition of organic matter.
(VIII) Design and operation of multistage reactor for degradation of waste water.
(IX) Isolation and purification of degradative plasmids for aromatic compounds.
(X) Word processing commands using MS-Word.
(XI) Mail Merge facility of MS-Word.
(XII) Graphical presentation using MS-Excel.
(XIII) Creation of Data tables in MS Access and simple queries with SQL.
(XIV) Online Bibliographic and patent search.
(XV) Offline Bibliographic search using Derwent Biotechnology Abstracts.
(XVI) Configuring and managing of e-mail accounts.
(XVII) Sequence information resource
(XVIII) Understanding and using on web: Embl, GEnbank, Entrez, Unigene
(XIX) Protein information resource
(XX) Understanding and using on web: PDB, Swissprot, TrEMBL
(XXI) Using BLAST and interpretation of results, multiple sequence alignment using ClustalW

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SYLLABUS FOR M.SC. MICROBIOLOGY

COURSE EL-301 : METABOLIC ENGINEERING

Maximum Marks - 80 **Teaching Hours - 45**

Note : Examiner will set 09 (nine) questions covering all topics/sections of the syllabus and at least one question from each section Out of the nine questions, there will be an objective type question covering entire syllabus which will be compulsory. The students will attempt five questions including the compulsory questions. All questions will carry equal marks.

Unit 1

Introduction to metabolic engineering: Concept and importance of metabolic engineering, improvement of microbial strain and fermentation processes by metabolic engineering.

Unit 2.

Regulation of metabolic pathways: Regulation of enzyme activity, regulation of enzyme concentration, regulation of metabolic network. tools of metabolic engineering.

Unit 3.

Metabolic engineering in practice: Enhancement of productivity, extension of substrate range, extension of product spectrum and novel products, improvement of cellular properties, intervention in health and diseases, xenobiotics degradation.

Unit 4. Metabolic flux analysis:

Theory, detection of elementary flux modes in biochemical network, metabolic flux distribution in *Corynebacterium glutamicum* during growth and lysine overproduction.

Unit 5.

Application of metabolic flux analysis: Calculation of theoretical yield, amino acid production by glutamic acid bacteria, metabolic flux in mammalian cell culture, metabolic engineering ob lactic acid bacteria, riboflavin production by *Bacillus subtilis*, metabolic engineering of *Saccharomyces cerevisiae*.

Books:

1. Metabolic Engineering by S. Y. Lee and E. P. Popoutsakis (Eds), Marcel Dekker, New York, USA.
2. Metabolic Engineering by G. N. Stephanopoulous, A. A. Aristidon, J, Neilson, Academic Press, USA.

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SYLLABUS FOR M.SC. MICROBIOLOGY

COURSE EL-302 : MICROBIAL ENZYMES

Maximum Marks - 80 **Teaching Hours - 45**

Note : Examiner will set 09 (nine) questions covering all topics/sections of the syllabus and at least one question from each section Out of the nine questions, there will be an objective type question covering entire syllabus which will be compulsory. The students will attempt five questions including the compulsory questions. All questions will carry equal marks.

Unit I

Natures of Enzymes-Structural and Functional aspects, physiological significance of enzymes, classification and nomenclature, importance of the study of enzymes.

Unit-II

Rate of enzyme catalyzed reactions, rate laws and rate constants, Michaelis Mentonôs hypothesis, significance and determination of Km and, Vmax, enzyme inhibition-reversible and irreversible inhibition, competitive, noncompetitive and uncompetitive inhibition, effect of physicochemical factors on enzyme activities.

Unit-III

Introduction and history of industrially important microbial enzymes, biochemistry and physiology of microbial enzyme production mechanism, regulation of enzyme synthesis, location and secretion of enzymes.

Unit-IV

Introduction, occurrence, mechanism of action, methods of industrial production and applications of amylases, proteinases, cellulases, pactinases, glucose oxidase, glucose dehydrogenase, glucose isomerase, B galactosidase, and invertases. Recovery of Microbial Enzymes, Introduction cell disruption, precipitation, solid/liquid separation, chromatographic techniques and drying.

Unit-V

Immobilization, development of immobilizaiton techniques, specific examples of immobilized microbial enzymes useful in food systems and biotechnology, immobilized enzymes reactors. Exploitation of microbial enzymes in food systems and biotechnology, increasing yields of extracellular enzymes-strain selection, environmental control, genetic regulatory controls, genetic recombination and gene amplification techniques.

Books:

1. Enzyme Technology - **M.F. Chaplin and D.C. Bucks**
2. Industrial Enzymology ï **Godfrey and West**
2. Enzyme ï **Copeland**
4. Enzymes in Industry ï **W. Gerhartz**

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SYLLABUS FOR M.SC. MICROBIOLOGY

COURSE EL-303 : MICROBIAL GENOMICS & PROTEOMICS

Maximum Marks - 80 **Teaching Hours - 45**

Note : Examiner will set 09 (nine) questions covering all topics/sections of the syllabus and at least one question from each section Out of the nine questions, there will be an objective type question covering entire syllabus which will be compulsory. The students will attempt five questions including the compulsory questions. All questions will carry equal marks.

Unit 1

Whole genome analysis, preparation of ordered cosmid libraries, bacterial artificial chromosome libraries, shotgun libraries and sequencing, conventional sequencing (Sanger, Maxam and Gilbert methods), automated sequencing.

Unit 2

Sequence analysis: computational methods, homology algorithms (BLAST) for proteins and nucleic acids, open reading frames, annotations of genes, conserved protein motifs related structure/function (PROSITE, PFAM, ProfileScan), DNA analysis for repeats (direct and inverted), palindromes, folding programmes.

Unit 3

Use of Internet, public domain databases for nucleic acid and protein sequences (EMBL, GenBank), database for protein structures (PDB).

Unit 4

DNA microarray, printing or oligonucleotides and PCR products on glass slides, nitrocellulose paper. Whole genome analysis for global patterns of gene expression using fluorescent labeled cDNA or end labeled RNA probes. Analysis of single nucleotide polymorphisms using DNA chips.

Unit 5

Proteome analysis: Two-dimensional separation of total cellular proteins, isolation and sequence analysis of individual protein spots by mass spectroscopy. Protein microarray. Advantages and disadvantages of DNA and protein microarrays.

Books:

1. The internet and the new biology: Tools for genomic and molecular research by Peruski. Jr and Peruski.
2. DNA microarrays: A practical approach edited by Mark Schena.

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COURSE 401 : RESEARCH PROJECT REPORT

Maximum Marks - 200

Each of the candidates will carry out the project work assigned to him/her. The candidate will submit three bound copies of the research project work performed by him/her duly certified by the guide/supervisor. The project report should cover the summary, introduction, materials and methods, results and discussion and references. The references will be arranged alphabetically under the format given below:

Referred Journal

Bhalla TC, Sharma NN and Sharma M (2006). Expression of alkaline protease in *Rhodococcus* sp. J Appl Biotechnol 32: 225-230.

Book

Demartino GN (1996). Purification of proteolytic enzyme. In: Proteolytic enzyme: a practical approach. Berjnon RJ and Bond JS eds, IRL Press, NewYork.

Thesis

Verma ML (2006). Production, purification and characterization of thermotolerant *P. aeruginosa* lipase. PhD Thesis, Himachal Pradesh University, Shimla, India.

Website

www.elsevier.com