CHOICE BASED CREDIT SYSTEM (CS)

SEMESTER PATTERN

M.Sc. IInd Year Microbiology (PG) Program under Faculty of Science

(Affiliated Colleges)

(w.e.f. Academic Year 2015-16)

Name of the Faculty	Total credit	Average credits per semester
Science	**100**	**25**

Note:

- Assessment shall consist of Continuous assessment **(CA)** and End of Semester Examination **(ESE).**
- **Weightage:** 75% for ESE & 25% for CA
- **Paper- (Elective):** Transfer of Credit as per Student choice

Distribution of Credits for M.Sc. II[nd] Year Microbiology under Science faculty (All Affiliated Colleges)

Semester	Paper No. & Code	Title of the subject	External (ESE)	Internal (CA)	Total
Sem. III	Paper-XI: MB-301	Molecular Immunology	(75 marks)	(25 marks) (2Test : 15 marks+ Assignments :10 marks)	Credit: 4 (100 marks)
	Paper-XII: MB-302	Recombinant DNA Technology	(75 marks)	(25 marks) (2Test : 15 marks+ Assignments :10 marks)	Credit: 4 (100 marks)
	Paper-XIII: MB-303	Microbial Diversity And Extremophiles	(75 marks)	(25 marks) (2Test : 15 marks+ Assignments :10 marks)	Credit: 4 (100 marks)
	*Paper-XIV (Elective): MB-304	Biostatistics, Computer Applications And Research Methodology	(75 marks)	(25 marks) (2Test : 15 marks+ Assignments :10 marks)	Credit: 4 (100 marks)
	Paper –XV (Seminar)	Based on theory paper MB-301, 302, 303 & 304		Credit: 1 (25 marks)	Credit: 1
				Total for Sem: III	**Credit: 17**
Sem. IV	Paper-XVI: MB-401	Fermentation Technology	(75 marks)	(25 marks) (2Test : 15 marks+ Assignments :10 marks)	Credit: 4 (100 marks)
	Paper-XVII; MB-402	Medical And Pharmaceutical Microbiology	(75 marks)	(25 marks) (2Test : 15 marks+ Assignments :10 marks)	Credit: 4 (100 marks)
	Paper-XVIII: MB-403	Environmental Microbiology	(75 marks)	(25 marks) (2Test : 15 marks+ Assignments :10 marks)	Credit: 4 (100 marks)
	*Paper-XIX (Elective): MB-404	Bioinformatics, Proteomics And Genomics	(75 marks)	(25 marks) (2Test : 15 marks+ Assignments :10 marks)	Credit: 4 (100 marks)
	Paper –XX (Seminar)	Based on theory paper MB-401, 402, 403 & 404		Credit: 1 (25 marks)	Credit: 1
				Total for Sem: IV	**Credit: 17**
Lab Course Work (Annual Practical)	LAB –V	Based on theory paper MB-301 & MB-302	(75 marks)	(25 marks)	Credit: 4 (100 marks)
	LAB –VI	Based on theory paper MB-303 & MB-304	(75 marks)	(25 marks)	Credit: 4 (100 marks)
	LAB –VII	Based on theory paper MB-401, 402, 403 & 404	(75 marks)	(25 marks)	Credit: 4 (100 marks)
	LAB –VIII (Dissertation) *(Elective)	----	(75 marks)	(25 marks)	Credit: 4 (100 marks)
	Total for Lab Course work(Annual)				**Credit: 16**
	Total for M.Sc. II Year: Sem. III + Sem. IV + Lab Course work (Annual)				**Credit: 50**
	Total for M.Sc.(I Year + II Year):				**Credit: 100**

MB 301: Molecular Immunology (Four Credits)

Unit I: Organs and cells of immune system. **(10)**

Primary lymphoid organs - thymus, bone morrow - structure and function. Lymphatic system - transporter of antigen - introduction. Secondary lymphoid organs – spleen and lymphnodes structure and functions. Mucosal associated lymphoid tissue, (MALT) - tonsils. Cutaneous associated lymphoid tissue - keratinocytes and langerhans cells - Location and immunological functions.

Lymphoid cells - B-lymphocytes and T-lymphocytes - maturations, activation and differentiation. Receptor on B and T cells. Null cells. γ δ T cells - Intraepithelial lymphocyte (IEL)- function, Mesanglial cells, Microglial cells - Structures and secretions - interleukin I, hydrolytic enzymes, complement proteins, α-Interferon, Tumor necrosis factor α (TNF-α) (IL-6, GM-CSF, G-CSF, M-CSF). Growth factors associated in haematopoiesis, Granulocytes - Neutrophile, Basophile, Eosinophile - immune response generated against parasite by granulocytes. Mast cell - Structure, function in innate immunity and acquired immunity. Dendritic cell - structure and function.

Unit II: Immunogens and Immunoglobulins. **(09)**

Types of antigens - Exogenous, Endogenous, Autologus, Xenogenic and Allogenic. General properties of antigens - Molecular size, chemical composition, foreignness, specificity, Haptens, Superaantigens and Adjuvants: Freund, complete and incomplete adjutants, Depot effect, Macrophage activation, Effect of lymphocyte, antitumor action,

Epitopes: A.A.sequence /structure. Immunoglobulins: Classes, Structure, distribution and function. Isotypic, Allotypic, Idiotypic determinants. Idiotype network. Antibody production theories.

Unit III: Organization and Expression of Immunoglobulin genes. (10)

Genetic model for Ig structure, Germ line and somatic variation models, Dryer and Bennett two gene models, K chain genes, λ chain genes, Heavy chain genes, VH gene segments, Gene rearrangement in VH region - In light chain, In heavy chain, Mechanism of variables region DNA rearrangement, Generation of antibody diversity, Regulation of Ig gene transcription

Unit IV: Major and Minor Histocompatibility Complexes. (08)

MHC class-I, MHC class-II - Structure of molecules, gene organization. Genetic polymorphism of molecule, Peptide interaction with molecule, MHC and immune responsiveness, MHC and susceptibility to infectious diseases, Minor MHA - structure, role and genetics, HLA system, Antigen processing and presentation

Unit V: Clinical immunology. (08)

Hypersensitivity, Immunology of Tumors, Immunodeficiency diseases, autoimmune diseases, Immunomodulation / Immunological tolerance.

PRACTICALS:

1. Ag – Ab reaction
   - Agglutination - Slide – widal test
     - Tube - Dreyer's technique
     - Bordet Durham's technique
     - Quantitative widal test.
   - * Precipitation - Slide - VDRL, RPR, RA
   - * Complement fixation test - Coomb's test (demonstration)

2. Radial Immunodiffusion.
3. Immunohaematology.
    * DLC, TLC, RBC count
    * Blood grouping - ABO system
        - Rh grouping
4. Separation of serum proteins by electrophoresis.
5. Preparation of 'H' antigen of S. typhi by Craigies tube method.
6. Preparation of 'O' antigen of S. typhi by phenol agar method.

REFERENCES -

1. *A handbook of practical immunology by* G. P. Talwar, Vikas Publishing House, New Delhi.
2. *Genes VII* by Benjamin Lewin, Oxford University Press.
3. *Immunology (2nd edition)* by C. Vaman Rao, Narosa publication.
4. *Immunology (2nd edition)* by Janis Kuby, W. H. Freeman and company.
5. *Immunology (8th Edition)* by D. M. Weir, Churchill Livingstone.
6. *Roitt's Essential Immunology (9th edition) by* Ivan Roitt, Blackwell Sciences.

MB 302: RECOMBINANT DNA TECHNOLOGY (Four Credits)

Unit I: Techniques and enzymes used in genetic engineering. (10)

Core techniques of gene cloning and essential enzyme used in genetic engineering: restriction endonucleases type I, II, III, restriction modification system: nomenclature and classification of type II endonucleases , their activity, DNA ligase: properties and specificities, S_1 nuclease, BAL $_{31}$ nuclease, DNA polymerase, polynucleotide kinase, phosphatase, reverse transcriptase and its activity and mode of action. Restriction digestion, ligation and transformation. Hybridization techniques: Northern, southern and colony hybridization, fluorescence *in situ* hybridization. Restriction map and mapping techniques, DNA fingerprinting, chromosome walking and jumping.

Unit II: Cloning vectors. (08)

Gene cloning vectors: plasmids and their properties, pBR 322 and pUC18 its derivatives and construction, single stranded plasmid, promoter probe vectors, runway plasmid vectors. Bacteriophage as cloning vectors, EMBL, λgt 10/11, λZAp etc. cosmid vectors. Artificial chromosome vectors (YAC, BACs). Animal virus derived vectors, SV_{40}vaccina/bacculo and retroviral vectors. Expression vectors, pMal, GST, pET based vectors.

Unit III: Cloning methodologies (10)

Insertion of foreign DNA into the host cells: transformation , transfect ion : chemical and physical method , liposomes, microinjection, electroporation, biolistic, somatic cell fusion , gene transfer by pronuclear microinjection , plant transformation technology : Basic of tumor formation, hairy root, features of Ti and Ri plasmids, mechanism of DNA transfer, role of virulence gene, use of Ti and Ri as plasmids vectors. Cloning and expression in yeast (*Saccharomyces, pichia* etc), animal and plant cells, methods of selection and screening, cDNA and genomic cloning, expression cloning, jumping and hopping libraries, phage display, construction of cDNA libraries in

plasmids and screening methodology, construction of cDNA and genomic DNA libraries in plasmids in lambda vectors, principles in maximizing gene expression.

Unit IV: Polymerase Chain Reaction. **(08)**

Primer design, fidelity of thermal enzymes, DNA polymerase, multiplex, nested reverse transcriptase, realtime PCR touchdown PCR, hot start PCR, colony PCR, cloning of PCR products, T vectors, proof reading enzymes, PCR in gene recombination , deletion , addition , overlap extension and SOEing , site specific mutagenesis, PCR in molecular diagnostics, viral and bacterial detection, PCR based mutagenesis.

Unit V: PCR application. **(09)**

sequencing methods: enzymatic DNA sequencing, chemical DNA sequencing of DNA, principles of automated DNA sequencing, RNA sequencing, chemical synthesis of oligonucleotides, gene silencing techniques: introduction to si RNA and si RNA gene technology, micro RNA, construction of si RNA vectors, principle and application of gene silencing and germ line therapy in vivo and ex-vivo, suicide gene therapy, gene replacement, gene targeting, RFLP, RAPD, AFLP analysis. Application of recombinant DNA technology in medicine, agriculture and veterinary sciences.

PRACTICALS:

1. Demonstration of gene cloning,
2. DNA fingerprinting.
3. DNA ligation by T4 DNA ligase.
4. DNA molecular size determination.
5. Isolation of genomic DNA and it's confirmation by Southern blotting
6. Isolation of plasmid DNA and its Restriction digestion.
7. PCR amplification from genomic DNA and analysis by agarose gel electrophoresis.
8. RAPD application.
9. Restriction mapping.

REFERENCES:

1. *DNA cloning: A practical approach* by D.M. Glover and D.D. Harmes, RL press, Oxford 1995.
2. *Essentials of molecular biology vol. I (A Practical Approach)* by Brown T.A., IRL press Oxford. 1995.
3. *From Gene to Clone* by E. L. Winnacker.
4. *Genetic engineering, principles and practice*, by Sandhya Mitra. Macmillan India Ltd.
5. *Genome mapping and sequencing* by Ian Dunham. Horizon Scientific press.
6. Manipulation and expression of Recombinant DNA. Robertson.
7. *Methods in enzymology gene expression technology* by D.A Godgel. Academic press Inc, San Diego.
8. *Methods in enzymology guide to molecular cloning techniques*, vol. 152 S. L. Berger. Academic press .Inc, san Diegn, 1996.
9. *Molecular biotechnology (2nd edition),* by S.B. Primrose, Blackwell Scientific publishers, Oxford.
10. *Molecular biotechnology: principles and application of Recombinant DNA II* by Bernard R. Glick and J. Pastemak, ASM publication.
11. *An introduction to genetic engineering* (2nd edition) by Nicholl D.S.T., Cambridge University press, Cambridge, U.K.
12. *PCR application. Protocol for functional genomics* by Michael A. Innis. David H., Gelfand John J. Sninsky, Academic Press.
13. *PCR technology- principles and application for DNA amplification* by Henry A Erilch (Ed) Stockton Press. 1989.
14. *Principles of gene manipulation, Old and Primrose* by Blackwell Scientific publication.
15. *Route maps in gene technology* by M.R. Walker and R. Rapley, Blackwell science, Oxford.
16. *Molecular cloning* by Sambrook J, Fritsch E.F and Maniatis, cold spring harbor laboratory press, New York.

MB 303 : MICROBIAL DIVERSITY AND EXTREMOPHILES (Four Crédits)

Unit 1: Biodiversity (09)

Introduction to microbial diversity-Distribution, Abundance, Ecological Niches. Types- Bacterial, Archael, Eucaryal, Characteristics and Classification of Archae (Metahnogens).

Unit 2: Thermophiles (09)

Classification, Hyper-thermophilic habitat and ecological aspects. Molecular basis of thermo-stability, Heat stable enzymes and metabolism, Genetics of thermophiles, Minimal complexity model systems.

Commercial aspects of thermophiles and application of thermoenzymes

Unit 3: Acidophiles and Alkalophiles (09)

Acidophiles- Classification, life at low pH, acido-tolerance, applications.

Alkalophiles- Isolation, Distribution and Taxonomy. Cell structures-Flagella, Cell wall, Cell membrane. Physiology- Growth conditions, Mutants, Antiporters and alkaliphily. Intracellular enzymes. Molecular biology- Alkalohiles as DNA sources, secretion vectors, promoters

Enzymes of alkaliphiles and their applications

Unit 4: Psychrophiles (09)

Conditions for microbial life at low temperature Climate of snow and ice, limits for life at subzero temperature.

Microbial diversity at cold ecosystem – snow and glaciers ice, subglacial environments, psychropiezophiles, permafrost, anaerobic and cyanobacteria in cold ecosystem, microalgae in Polar Regions.

Molecular adaptations to cold habitats – Membrane components and cold sensing, cold adapted enzymes, cryoprotectants and ice binding proteins , role of exopolymers in microbial adaptations to sea ice

Unit 5: Halophiles and Barophiles (09)

Halophiles- Classification, Halophilicity and Osmotic protection, Hypersaline Environments, Eukaryotic and prokaryotic halophiles Halobacteria – cell wall. Membranes, compatible solutes, osmo-adaptations or halotolerance, Applications of halophiles and their extremozymes.

Barophiles- Classification, high pressure habitat, life under pressure, barophily, death under pressure.

PRACTICALS:

1. Isolation of thermophiles from hot water spring (Study at least one thermostable enzyme).
2. Studies on halophiles isolated from high salt habitat. (Study its pigmentation and salt tolerance phenomenon).
3. Studies on alkalophiles and its enzymes (any one) isolated form extreme alkaline environment.
4. Biogenic methane production using different wastes.
5. Isolation of *Thiobacillus ferrooxidans* and *Thiobacillus thiooxidans* culture from metal sulfides, rock coal and acid mine water.

REFERENCES:

1. *Advances in applied microbiology*. Vol.X, by Wayne W. Umbreit and D. Pearlman Academic Press.
2. *Brock biology of Microorganisms. XI* by Michael T. Madigan, John M. Martinko. Pearson Education International.
3. *Extreme environment. Metabolism of microbial Adaptation* by Milton R., Heinirich Academic Press.
4. *Extremophiles* by Johri B.N. 2000. Springer Werlag, New York.
5. *Microbial diversity* by Colwd D., 1999, Academic Press.
6. *Microbial ecology. Fundamental and applications* by Ronald M. Atlas and Richard Bartha. II and IV edition.
7. *Microbial Ecology*. IInd edition by R. Campbell. Blackwell scientific publication.
8. *Microbial life in extreme Environment* by D.J. Kushner. Academic Press.
9. *Microbiology: Dynamics and Diversity* by Perry.

10. *Microbiology of Extreme Environment* by Clive Edward. Open University Press. Milton Keynes.
11. *Microbiology of extreme Environment and its potentials for Biotechnology* by N. S. Da Coasta, J. C. Duarata,, R.A.D. Williams. Elsisver applied science, London
12. *Thermophiles. General, Molecular and applied Microbiology* by Thomas D.Brock. Wiley Interscience publication.

MB 304: Biostatistics, Computer Applications and Research Methodology (Four Credits)

(ELECTIVE)

Unit I: Introduction to biostatistics. (08)

Basic definitions and applications, sampling representative sample size, sampling bias and sampling techniques. Data collection and presentation: types of data, methods of collection of primary and secondary data, methods of data collection, graphical representation by histogram, polygon, ogive curves and pie diagram.

Unit II: Measures of central tendency. (09)

Measures of central tendency: mean, median, mode.

Measures of variability of variation. Correlation and regression: positive and negative correlation and calculation of Karl Pearson co-efficient of correlation. Linear regression and regression equation and multiple linear regressions. ANOVA, one and two way classification. Calculation of an unknown variable using regression equation.

Unit III: Tests of significance. (10)

Tests of significance: small test (Chi-square t-test, F-test), large sample test (Z-test) and standard error. Introduction to probability theory and distribution (concept without deviation) binomial poison and normal (only definitions and problems) computer oriented statistical techniques. Frequency table of single discrete variable, bubble spot. Computation of mean, variable and standard deviations, t test, correlation coefficient.

Unit IV: Computer: Introduction and application. (10)

Introduction to computers and computer applications: Introduction to computers, Computer applications in research, basics, organization, PC, mainframes and Super-computers, concept of hardware and software, concept of file, folders and directories, commonly used commands, flow charts and programming techniques. Introduction in MS Office software concerning Word processing, spreadsheets and presentation software.

Unit V: Scientific writing in research. (08)

Research: Definition, importance and meaning of research, characteristics of research, types of research, steps in research, identification, selection and research problems, formulation of hypothesis.

Scientific writing- characteristics. Logical format for writing thesis and papers. Essentials features of abstract, introduction, review of literature, materials, methods, and discussion. Effective illustration- table and figures. Reference styles- Harvard and Vancouver systems.

PRACTICALS:

1) Representation of statistical data by
    a) Histogram b) Ogive curve c) Pie diagram.
2) Determination of statistical averages / central tendencies.
    a) Arithmetic mean
    b) Median
    c) Mode.
3) Determination of measure of dispersion.
    a) Mean deviation.
    b) Standard deviation and coefficient of variation.
    c) Quartile deviation.
4) Tests of significance-Application of following.
    a) Chi-square test.
    b) t-test
    c) standard error
5) Creating files, folders and directories.
6) Application of computers in biology using MS-office.
    a) MS-word
    b) Excel
    c) Power point.
7) Creating and e-mail account, sending and receiving mails.

8) An introduction to Internet, search engines, websites, browsing and downloading.

REFERENCES:

1) *Biostatistical methods* by John M. Lachin. John Wiley & Sons.
2) *Biostatistics- 7th edition* by Wayne W. Daniel. John Wiley & Sons.
3) *Fundamentals of biostatistics* by Irfan A Khan, Atiya Khanum. Ukaaz Publications.
4) *How computer work* (2000) by Ron White. Tech Media.
5) *How the internet work* (2000) by Preston Garlla Tech. Media.
6) *Practical statistics for experimental biologist* by Alastair C. Wardlaw. Wiley.
7) *Research methodology methods and statistical techniques* by Santosh Gupta. Deep & Deep Publications.
8) *Research methodology methods and techniques* by C.R. Kothari. New Age International.
9) *Research methods in Biological sciences* by Palanisamy S. and M. Shanmugavelu. 1997. Palani Paramount publications, Tamilnadu. India
10) *Statistics for biologist* by Campbell R.C (1974). Cambridge University Press, UK.
11) *Statistics in biology Vol: 1* by Bliss, C.I.K (1967) Mc Graw Hill, New York.

MB - 305: Seminar

Based on theory paper MB-
301, 302, 303 & 304

Paper: MB: 305
CREDIT: I
W.E.F.: June 2015

SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY, NANDED

CBCS Syllabus for M.Sc. IInd Year (MICROBIOLOGY)

(Effective progressively from June 2015)

FOURTH SEMESTER

MB 401: FERMENTATION TECHNOLOGY (Four Credits)

Unit I: Microbial fermentations **(09)**

Metabolic pathways and metabolic control mechanisms, Industrial production of citric acid, lactic acid, enzymes (alpha amylase, lipase, xylase , pectinases, proteases) Acetone-butanol, Lysine and Glutamic acid, Alcoholic beverages, Distilled beverages, Beer, Wine.

Unit II: Microbial production of therapeutic compounds **(08)**

Microbial production of therapeutic compounds (β-lactum, aminoglycosides, ansamycines (Rifamycin), Peptide antibiotics (Quinolinones), Biotransformation of steroids, Vit.B-12 and riboflavin fermentation.

Unit III: Modern trends in microbial production **(08)**

Modern trends in microbial production of bioplastics (PHB,PHA), Bioinsecticides (thuricides) Biopolymer (dextran, alginates, xanthan, pullulan), Biofertilizer (nitrogen fixer Azatobacter , phosphate solubilising microorganisms), Single cell protein and production of biological weapons with reference to anthrax.

Unit IV: Biofuels **(09)**

Useful features of biofuels. The substrate digester and the microorganisms in the process of biogas production (Biomethanation). Production of bioethanol from sugar, molasses, starch and cellulosic materials. Ethanol recovery. Microbial production of hydrogen gas, biodiesel from hydrocarbons.

Unit V: Immobilization techniques, IPR and Patents **(11)**

Some industrial techniques for whole cell and enzyme immobilization. Application and advantages of cell and enzyme immobilization in pharmaceutical, food and fine chemical industries. Intellectual Property Rights (IPR), Patents, Trademarks, copyrights, secrets, Patenting of biological materials, International co-operation, Obligations with patent

applications, implication of patenting, current issues, hybridoma technology etc. Patenting of higher plants and animals, transgenic organisms and isolated genes, patenting of genes and DNA sequences, plant breeders rights and farmers rights.

PRACTICALS:

1) Production and characterization of citric acid using *A. niger*.
2) Microbial production of glutamic acid.
3) Production of rifamycin using *Nocardia* strain.
4) Comparison of ethanol production using various organic wastes/raw materials. (Free cells / immobilized cells).
5) Production and extraction of thuricides.
6) Laboratory scale production of biofertilizers. (Nitrogen fixer/ Phosphate solubilizers/ Siderophore producers).
7) Microbial production of dextran by *Leuconostoc mesenteroids*.
8) Microbial production of hydrogen gas by algae.

REFERENCES:

1) *Annual report in fermentation processes* by D. Pearlman, Academic Press
2) *Annual Review of Microbiology* by Charles E. Cliffton (Volumes)
3) *Biology of industrial microorganisms* by A. L. Demain.
4) *Biotechnology. A Text Book of Industrial Microbiology* by Creuger and Creuger. Sinaeur associates.
5) *Fundamentals of Biochemical Engineering* by Bailey and Ollis.
6) *Genetics and Biotechnology of Industrial Microorganisms* by C. L. Hershnergey, S.W. Queener and Q. Hegeman. Publisher ASM. Ewesis ET. Al 1998 Bioremediation Principles. Mac Graw Hill.
7) *Industrial microbiology* by G. Reed (ed), CBS publishers (AVI publishing comp.).
8) *Manual of Industrial Microbiology and Biotechnology* 2nd edition by Davis J.E. and Dmain A. L. ASM Publication.

MB 402: MEDICAL AND PHARMACEUTICAL MICROBIOLOGY (Four credits)

Unit I: Antibiotics and synthetic antimicrobial agents. (09)

Antibiotics and synthetic antimicrobial agents (Aminoglycosides, β lactums, tetracyclines, ansamycins, macrolid antibiotics). Antifungal antibiotics, antitumour substances. Peptide antibiotics, chloramphenicol, sulphonamides and quinolinone antimicrobial agents. Chemical disinfectants, antiseptics and preservatives.

Unit II: Mechanism of action of antibiotics. (09)

Mechanism of action of antibiotics (inhibitors of cell wall synthesis, nucleic acid and protein synthesis). Molecular principal of drug targeting. Drug delivery system in gene therapy. Bacterial resistance to antibiotics, quionolinones. Mode of action of bacterial killing by quinolinones. Mode of action of non-antibiotic antimicrobial agents. Penetrating defenses –How the antimicrobial agents reach the targets (cellular permeability barrier, cellular transport system and drug diffusion).

Unit III: Microbial production and spoilage of pharmaceutical products. (09)

Microbial production and spoilage of pharmaceutical products (sterile injectable, non injectable, ophthalmic preparation and implants) and their sterilization. Manufacturing procedure and in process control of pharmaceuticals. Other pharmaceuticals produced by microbial fermentations (streptokinase, streptodornase). New vaccine technology, DNA vaccines, synthetic peptide vaccines, multivalent subunit vaccines. Vaccine clinical trials.

Unit IV: Regulatory practices, biosensors and applications in pharmaceuticals.

(09)

Finiancing R & D capital and market outlook, IP, BP, USP. Government regulatory practices and policies, FDA perspective. Reimbursement of drug and biological, legislative perspective. Rational drug design. Immobilization procedures for pharmaceutical applications (liposomes). Macromolecular, cellular and synthetic drug

carriers. Biosensors in pharmaceuticals. Applications of microbial enzymes in pharmaceuticals.

Unit V: Quality assurance and validation. (09)

Good manufacturing practices (GMP) and Good laboratory practices (GLP) in pharmaceutical industry. Regulatory aspects of quality control. Quality assurance and quality management in pharmaceuticals ISO, WHO and US certification. Sterilization control and sterility testing (heat sterilization, D value, z value, survival curve, radiation, gaseous and filter sterilization). Chemical and biochemical indicators. Design and layout of sterile product manufacturing unit (Designing of microbiology laboratory). Safety in microbiology laboratory.

PRACTICALS:

1) Spectrophotometeric/ Microbiological methods for the determination of Griseofulvin.
2) Microbial production and Bioassay of Penicillin.
3) Bioassay of Chloramphenicol/Streptomycin by plate assay method or turbidometric assay methods.
4) Screening, Production and assay of therapeutic enzymes: Glucose Oxidase/Asperginase/beta lactamase.
5) Treatment of bacterial cells with cetrimide, phenol, and detection of Leaky substances such as amino acids, nucleic acids as cytoplasmic membrane damaging substances.
6) Determination of MIC and LD50 of Ampicillin / Streptomycin.
7) Sterility testing by using *B. sterothermophilus / B. subtilis.*
8) Testing for microbial contamination. Microbial loads from syrups, suspensions, creams, and other preparations, Determination of D-value and Z-value for heat sterilization in pharmaceuticals.
9) Determination of antimicrobial activity of chemical compounds (like phenol, resorcinol and formaldehydes) Comparison with standard products.

REFERENCES:

1) *Analytical Microbiology* by Fredrick Kavanagh volume I &II. Academic Press New York.
2) *Biotechnology – Expanding Horizon* by B.D. Singh., First Edition, Kalyani Publication, Delhi.
3) *Biotechnology* by H.J. Rhem & Reed, vol 4 VCH publications, Federal Republic of Germany.
4) *Drug carriers in biology & medicine* by Gregory Gregoriadis. Acedemic Press New York.
5) *Good manufacturing practices for Pharmaceuticals* By Sydney H. Willing, Murray M. Tuckerman, Willam S. Hitchings IV. Second edition Mercel Dekker NC New York.
6) *Lippincott's illustrative Reviews: Pharmacology* Edition: 02 Maryjnycck by Lippincott's review Publisher Pheladelphia 1997.
7) *Pharmaceutical Biotechnology* by S. P. Vyas & V.K. Dixit. CBS publishers & distributors, New Delhi.
8) *Pharmaceutical Microbiology* by W. B. Hugo & A.R. Russel Sixth Edition. Blackwell Scientific Publications.
9) *Pharmacognosy* by Gokhle S.D., KoKate C.K. Edition: 18, Nirali Publication.
10) *Principles of medicinal chemistry* Vol. 1 by Kadam S.S., Mahadik K.R., Bothra K.G. Edition: 18, Nirali Publication.
11) *Quality Assurance in Microbiology* by Rajesh Bhatia, Rattan Lal Ihhpunjani. CBS publishers & distributors, New Delhi.
12) *Quality control in the Pharmaceutical industry* by Murray S. Cooper Vol. 2, Academic Press New York.
13) *Quniolinone antimicrobial agents* by David C. Hooper, John S. Wolfson. ASM Washington DC.

MB 403: ENVIRONMENTAL MICROBIOLOGY (Four Credits)

Unit I: Environment and Ecosystems (08)

-Definitions, biotic & abiotic environment, environmental segments.

-Composition and structure of environment.

-Concept of biosphere, communities and ecosystems.

-Ecosystems characteristics structure and function.

-Food chains, Food webs and Trophic structures, Ecological pyramid.

Unit II: Waste water and Solid Waste Treatment (12)

-Need for water management,

-Sources of measurement of water pollution, waste types solid and liquid.

-Waste characterization: physical, chemical and biological.

-Waste treatments: Primary, Secondary & tertiary treatments.

Aerobic – Trickling filters, oxidation ponds.

Anaerobic– Anaerobic digestion, Anaerobic filters & upflow anaerobic sludge.

- Effluent treatment Schemes for Dairy, Distillery, Tannery, Sugar and antibiotic industry (Types, Microbes used, types of effluent treatment plants.)

- Bioconversion of solid waste & utilization as fertilizer.

- Bioaccumulation of heavy metal ions from industrial Effluents.

Unit III: Biodeterioration, Biotransformation & Recovery of Metals & Metalloids. (08)

- Concept of Biodeterioration.

- Biodeterioration of paints, paper & Leather.

-Biochemistry and Microorganisms involved in recovery of Metals and Oil.

-Microbial transformation of Mercury & Arsenic.

Unit IV: Bioremediation of Xenobiotics. (09)

Microbiology of degradation of xenobiotics in the environment, Ecological considerations, Decay behavior. Biomagnification and degradative plasmids, hydrocarbons, substituted hydrocarbons, Oil pollution, Surfactants and Pesticides.

GMO'S & its environmental impact assessment and ethical issues.

Unit-V: Global environmental problems, Impacts and Management. (08)

Biotechnological approaches for tackling following issues

a) Ozone depletion and UV –B.
b) Green House Effect and CFC.
c) Acid rain & CO_2, SO2.
d) Acid mine drainage & H_2SO_4.
e) Eutrophication and P, N.
f) Biocorrosion.

PRACTICALS:

1. Physical analysis of sewage/industrial effluent by measuring total solids, total dissolved solids and total suspended solids.
2. Determination of indices of pollution by measuring BOD/COD of different effluents.
3. Bacterial reduction of nitrate from ground waters
4. Isolation and purification of degradative plasmid of microbes growing in polluted environments.
5. Recovery of toxic metal ions of an industrial effluent by immobilized cells.
6. Utilization of microbial consortium for the treatment of solid waste [Muncipal Solid Waste].
7. Biotransformation of toxic chromium (+ 6) into non-toxic (+ 3) by Pseudomonas species.
8. Tests for the microbial degradation products of aromatic hydrocarbons /aromatic compounds
9. Reduction of distillery spent wash (or any other industrial effluent) BOD by bacterial cultures.
10. Microbial dye decolourization/adsorption.

REFERENCES:

1. *A Manual of Environmental Microbiology*. 2nd Edition. 2001 by Christon J. Hurst (Chief Editor), ASM Publications.
2. *Advances in Waste Water Treatment Technologies*. 1998. Volumes II and I by R. K. Trivedy. Global Science Publication.
3. *Basic Principles of Geomicrobiology* by A. D. Agate, Pune.
4. *Biocatalysis and Biodegradation: Microbial transformation of organic compounds. 2000* by Lawrence P. Wacekett, C. Douglas Hershberger. ASM Publications.
5. *Bioremediation* by Baker K.H. And Herson D.S. 1994. MacGraw Hill Inc. N.Y.
6. *Chemistry and Ecotoxicology of pollution*. Edited by Des. W. Connell, G.J. Miller. WileyInterscience Publications.
7. *Environmental Biotechnology* by C. F. Forster and D.A., John Wase. Ellis Horwood Ltd. Publication.
8. *Environmental Microbiology* by Ralph Mitchell. A John Wiley and Sons. Inc.
9. *Pollution: Ecology and Biotreatment* by Ec Eldowney, S. Hardman D.J. and Waite S. 1993. - Longman Scientific Technical.
10. *Waste Water Engineering - Treatment, Disposal and Re-use* by Metcalf and Eddy, Inc., Tata MacGraw Hill, New Delhi.
11. *Waste Water Microbiology* 2nd Edition by Bitton.

MB 404: BIOINFORMATICS, PROTEOMICS AND GENOMICS (Four Credits)

(ELECTIVE)

Unit I: Introduction to Bioinformatics. (08)

Definition and history of bioinformatics. Internet and bioinformatics. Introduction to data mining. Applications of data mining.

Biocomputing: Introduction to string matching algorithms. Database search technique sequence comparison and alignment technique.

Unit II: Biological database. (12)

Database, Database management system, biological databases and information resources, classification of biological databases, PubMed- the central repository for biological database, ENTREZ, linking databases with sequence retrieval system, online mendelian inheritance in man, ExPASy, EMBL nucleotide sequence database, Ensembl.

Sequence alignment: Introduction, biologically motivated problems in computer science, similarity and difference of DNA, Nomenclature. Alignment: Pairwise alignment, scoring function insequence alignment, models for alignment, global alignment, local alignment, end-space free alignment, gap penalty. Database similarity searching: BLAST search, FASTA, PAM units and PAM matrices.

Unit III: Multiple sequence alignment. (08)

Introduction, multiple alignments to a phylogenetic tree, dynamic programming and computational complexity, progressive alignment method.

Multiple sequence alignment of related sequence: Position specific scoring matrices, profiles, PSI-BLAST, Markov Model or Markov chain, genetic algorithms and simulated annealing, identification of motifs and domains in multiple sequence alignment.

Unit IV: Proteomics. (09)

Introduction, methods of studying proteins.

Proteomics databases: varieties of protein databases, protein sequence databases, protein family databases, protein data bank, protein structure classification, protein

structure prediction, protein functions, protein-protein interactions, practical applications of proteomics.

Unit V: Genomics. (08)

Introduction, genomics, genome mapping, genome projects, methods for gene sequence analysis, types of genomics, gene functions, analysis of gene expression, significance of genome sequencing, human genome project, identifying gene involved in human disease, gene therapy, drug designing.

PRACTICALS:

Use of Internet /software for sequence analysis of nucleotides and proteins.

1. Studies of public domain databases for nucleic acid and protein sequences.
2. Determination of protein structure (PDB) by using RASMOL, CN -3D software
3. Genome sequence analysis by using BLAST algorithm
4. Protein sequence analysis by using BLAST algorithm

REFERENCES:

1) *Bioinformatics Methods and Protocols* - Misener.
2) *Bioinformatics - A Practical Guide to the Analysis of Genes and Proteins. 2nd Edition* by Baxevanis.
3) *Bioinformatics - from Genomes to drug. 2 volumes* by Lenganer.
4) *Bioinformatics 2000* by Higgins and Taylor OUP.
5) *Bioinformatics and molecular evolution* – P.G. Higgs & T. K. Attwood, 2005 Blackwell Publishing.
6) *Bioinformatics* by David Mount.
7) *Bioinformatics- Introduction to Bioinformatics* by Pevzner
8) *Bioinformatics. 1998* by Baxevanis
9) *Bioinformatics* byPrakash S. Lohar., MJP publisher.
10) *Bioinformatics: Sequence, structure and Data Bank: A Practical Approach* by Higgis.
11) *Computer analysis of sequence data* by Colte.
12) *DNA microarrays: A practical approach* edited by Mark Schena (OUP)
13) *Essential Bioinformatics* by JIN XIONG 2006 Cambridge University press.
14) *Functional Genomics. A Practical Approach* Edited by Stephen P Hunt and Rick Liveey (OUP) 2000.
15) *Introduction to Bioinformatics* by Altwood.

16) *Microarray Data Analysis Methods and Applications* Edited by Michael J. Korenberg 2007 Humana Press Inc.
17) *Microarray- Gene expression Data analysis* by Causton, Brazma 2003 Blackwell Publishing
18) *Protein Biotechnology* by Felix Franks. Humana Press, Totowa, New Jarsey.
19) *Protein Engineering: Principles and Practice* by Cleland.

Web sites for Proteomics and Genomics

1) www.geneprot.com.
2) www.hybrigenis.com
3) www.mdsproteomics.com
4) www.stromix.com
5) www.syrrx.com

MB - 405: Seminar

Based on theory paper MB-
401, 402, 403 & 404

Paper: MB: 405
CREDIT: I
W.E.F.: June 2015

Swami Ramanand Teerth Marathwada University, Nanded.

Model Question Paper Pattern (Theory) with effective from 2015
Class: **M. Sc. Second Year** (Semester III & IV) CBCS Pattern
Subject: MICROBIOLOGY
Papers: **MB-301 to 304** and **MB-401 to 404**

Time: Three Hrs **Max. Marks: 75 (ESE)**

NB: All questions are compulsory

Q. 1: Essay Type Question (On Unit I)		15 Marks
	OR	
a) Short Question		8 Marks
b) Short Question		7 Marks
Q. 2: Essay Type Question (On Unit II)		15 Marks
	OR	
a) Short Question		8 Marks
b) Short Question		7 Marks
Q. 3: Essay Type Question (On Unit III)		15 Marks
	OR	
a) Short Question		8 Marks
b) Short Question		7 Marks
Q. 4: Essay Type Question (On Unit IV)		15 Marks
	OR	
a) Short Question		8 Marks
b) Short Question		7 Marks
Q. 5: Essay Type Question (On Unit V)		15 Marks
	OR	
a) Short Question		8 Marks
b) Short Question		7 Marks

Swami Ramanand Teerth Marathwada University, Nanded.

Model Question Paper Pattern (Theory) with effective from 2015
Class: **M. Sc. Second Year** (Semester III & IV) CBCS Pattern
Subject: MICROBIOLOGY
Practical Paper LAB-V (Based on theory Papers: MB-301 to 302) (Morning) &
LAB-VI (Based on theory papers: MB-303 to 304) (Evening)
For two Consecutive days for each batch
Time: Four Hrs (Morning: 09amTo 1pm &Evening: 2 pm To 6 pm) **Max. Marks: 75 (ESE)**

Q. 1: Long Experiment (MB-301/MB-303)	15
Q. 2: Long Experiment (MB-302/MB-304)	15
Q. 3: Short Experiment (MB-301/MB-303)	10
Q. 4: Short Experiment (MB-302/MB-304)	10
Q. 5: Record Book	10
Q. 6: Viva Voce	15

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Swami Ramanand Teerth Marathwada University, Nanded.

Model Question Paper Pattern (Theory) with effective from 2015
Class: **M. Sc. Second Year** (Semester III & IV) CBCS Pattern
Subject: MICROBIOLOGY
Practical Paper LAB-VII (Based on theory Papers: MB-401,402,403 & 404)
LAB –VIII (Dissertation) *(Elective)
For two Consecutive days for each batch
Time: Four Hrs (Morning: 09 amTo 1pm) **Max. Marks: 75 (ESE)**

Q. 1: Long Experiment (MB-401)	12
Q. 2: Long Experiment (MB-402)	12
Q. 3: Long Experiment (MB-403)	12
Q. 4: Long Experiment (MB-404)	12
Q. 5: Record Book	12
Q. 6: Viva Voce	15