

Deccan Education Society's
FERGUSON COLLEGE, PUNE
(AUTONOMOUS)

M.Sc. II Microbiology syllabus

SEMESTER – III

Academic Year 2017-2018

MIC5301 IMMUNOLOGY

Unit 1	<p>Cell cell interaction through surface receptors and signal transduction pathways</p> <ol style="list-style-type: none">1. Structure and function , Toll-like receptors, Cytokine receptors, T2. Cell receptor, B Cell Receptor, adhesion molecules in immune activation3. Tyrosine kinase linked receptors, TCR-CD3 complex, Signal transduction pathways: IL-2 pathway (JAK/STAT and Ras/MAP Kinase Pathways) <p>References</p> <ol style="list-style-type: none">1. Akihiko Yoshimura, Tetsuji Naka and Masato Kubo, (2007), <i>SOCS proteins, cytokine signaling and immune regulation</i>, Nature Reviews, Immunology, 7:454-4652. Austyn J. M. and Wood K. J. (1993) <i>Principles of Molecular and Cellular Immunology</i>, Oxford University Press,3. Barret James D. (1983) <i>Text Book of Immunology</i> 4th edition, C. V. Mosby & Co. London.4. Boyd William C. (1966) <i>Fundamentals of Immunology</i>, Interscience Publishers, NY.5. Christopher K. Garcia and Erin J. Adams, (2005), How the T Cell Receptor Sees Antigen—A Structural View, <i>Cell</i>, Vol. 122: 333– 336, Elsevier Inc.6. David A. Hafler, (2007), <i>Cytokines and interventional immunology</i>, Nature Reviews, Immunology, 7: 4237. GangalSudha and SontakkeShubhangi (2013), <i>Textbook of Basic and Clinical Immunology</i> Paperback, University Press, India8. Kindt, Osborne, Goldsby, (2006), <i>Kuby Immunology</i>, 6th Ed., W. H. Freeman & Co.
Unit 2	<p>Regulation of Immune response</p> <p>A) Immunological tolerance and suppression:</p> <ol style="list-style-type: none">a. Negative regulation - Immunological tolerance, Mechanisms of tolerance induction (related experimentation using transgenic animals), T cell mediated suppression of immune responseb. Network theory and its experimental evidence <p>B. Cytokine mediated cross regulation of immune response Regulation of T_H subsets (TH1-TH2)</p> <p>C. Regulation of complement system – Classical and alternative pathway</p> <ol style="list-style-type: none">e. Immunomodulation: BRMs for therapy <p>References</p> <ol style="list-style-type: none">1. Abbas A. K. and Litchman A. H. (2004), <i>Basic Immunology, Functions and Disorders of Immune System</i>, 2nd Ed., Elsevier Inc.2. Akihiko Yoshimura, Tetsuji Naka and Masato Kubo, (2007), <i>SOCS proteins, Cytokine signaling and Immune regulation</i>, Nature Reviews, Immunology, 7:454-4653. BhushanPatwardhan, Sham Diwanay and Manish Gautam. (2006). <i>Botanical</i>

	<p>Immunomodulators and Chemoprotectants in Cancer Therapy. In <i>Drug discovery and development Volume I</i>:</p> <ol style="list-style-type: none"> 4. <i>Drug Discovery</i>. Ed. ChorghadeMukund S., (2006), Wiley-Interscience, John Wiley and Sons Inc. USA. 405-424. 5. Kindt, Osborne, Goldsby, (2006), <i>Kuby Immunology</i>, 6th Ed., W. H.Freeman& Co. 6. Michael C Carroll, (2004), <i>The complement system in regulation of adaptive immunity</i>, Nature Immunology 10:981-986 7. Michael C Carroll, (2004),<i>The complement system in regulation of adaptive immunity</i>, Nature Immunology, 5(10):981-986 8. Roitt I. M. (1988) <i>Essentials of Immunology</i>, ELBS, London. 9. Roitt M. (1984) <i>Essentials of Immunology</i>, P. G. Publishers Pvt. Ltd., New Delhi.
Unit 3	<p>Tumor Immunology</p> <ol style="list-style-type: none"> 1. Cellular transformations during neoplastic growth, Classification of tumors based on histological, 2. physiological, biochemical and immunological properties, Tumors of lymphoid system (lymphoma,myeloma, Hodgkin’s disease) 3. Escape mechanisms of tumor from host defense, Host immune response to tumor – Effectormechanisms, Immuno- surveillance theory c. Diagnosis of tumors – biochemical and immunological tumor markers 4. Approaches in cancer immunotherapy: Immune adjuvant and tumor vaccine therapy <p>References</p> <ol style="list-style-type: none"> 1. Ann M. Leen, Cliona M. Rooney and Aaron E. Foster, (2007), Improving T Cell Therapy for Cancer, Ann. Rev. Immunol.25:243–65 2. BhushanPatwardhan, Sham Diwanay and Manish Gautam.(2006). Botanical Immunomodulators and ChemoprotectantsinCancer Therapy. In <i>Drug discovery and development Volume I</i>: 3. <i>Drug Discovery</i>. Ed. ChorghadeMukund S., (2006), Wiley-Interscience, John Wiley and Sons Inc. USA. 405-424.3. Chatterji C. C. (1992) <i>Human Physiology</i> Vol. 1 &2, Medical Allied Agency, Calcutta. 4. Guyton A. C. and Hall J. E. (1996) <i>Text Book of Medical Physiology</i>, Goel Book Agency, Bangalore. 5. Malati T. (2007), <i>Tumor Markers: An Overview</i>, Indian Journal of Clinical Biochemistry, 22(2):17-31 6. Rev., 435 2:605-611Bendelac Albert, Paul B. Savage, and Luc Teyton, (2007), <i>The Biology of NKT Cells</i> Ann. Rev. Immunol. 25:297–336 7. Sham Diwanay, Manish Gautam and BhushanPatwardhan. (2004). <i>Cytoprotection and Immunomodulation in Cancer Therapy</i>.Current Medicinal Chemistry – Anti-Cancer Agents, 4: 479-490 8. Stuhler G. and Walden P. (2002), <i>Cancer Immune Therapy – Current and Future Strategies</i>, Wiley-VCH
Unit 4	<p>Immunological disorders</p> <p>Autoimmunity-Mechanism, theories, pathophysiology and therapeutic approaches for Rheumatoid arthritis, Systemic Lupus Erythomatosus (SLE), Neurologic disease-</p>

Myasthenia gravis

Pathophysiology, diagnosis, prognosis and therapeutic approaches to:

a. Immunodeficiency disorders – humoral deficiencies, T-cell deficiencies, and combined deficiencies, complement deficiencies

References

Abbas A. K. and Litchman A. H. (2004), *Basic Immunology, Functions and Disorders of Immune System*, 2nd Ed., Elsevier Inc.

Baron D. N. *Short Text book on Chemical Pathology*, ELBS, London.

Garrison Fathman¹ C., Luis Soares, Steven M. Chan¹ & Paul J. Utz¹, (2005), *An array of possibilities for the study of autoimmunity*, Nature

Rabson A., Ivan M. Roitt and Peter J. Devles, (2005), *Really Essential Medical Immunology*, 2nd Ed., Blackwell Publishing Ltd.

Stites D. P., Stobo J. D., Fudenberg H. H. and Wells J. V., (1982), *Basic and Clinical Immunology*, 4th Ed., Lange Medical Publications, Maruzen Asia Pvt. Ltd., Singapore

MIC5302 MOLECULAR BIOLOGY

Unit 1	<p>Chromatin organization and function</p> <ol style="list-style-type: none">1) Structure of chromatin, nucleosome, chromatin organization and remodeling, Higher order organization - chromosome, centromere, telomere2) Concept of epigenetics: DNA methylation, histone modifications, epigenetic inheritance, genomic imprinting, effect of environment on epigenetic changes3) C value paradox and genome size, cot curves, repetitive and non-repetitive DNA sequence, Cot $\frac{1}{2}$ and Rot $\frac{1}{2}$ values4) Pseudogenes , Gene families, Gene clusters, Super-families <p>References:</p> <ol style="list-style-type: none">1) James D. Watson, Tania Baker, Stephen P. Bell, Alexander Gann, Michael Levine, Richard Loswick (2004) <i>Molecular Biology of the Gene</i>, 5th Edition, Pearson Education, Inc. and Dorling Kindersley Publishing, Inc.2) Lewin's Genes XI, (2014) Jones and Bartelett Publishers Inc.3) Molecular Biology of the Cell, Bruce Albert et. al. , 6th Edn., Garland Sciences.4) Molecular Biology, Lodish et. al., 7th Edn., W. H. Freeman, 2012
Unit 2	<p>Eukaryotic transcription and processing of RNA</p> <ol style="list-style-type: none">1) Eukaryotic RNA polymerases I, II and III and their promoters, Enhancers, TATA box Binding Protein (TBP)2) Processing of RNA: RNA splicing- group I, group II introns, Capping of mRNA and polyadenylation3) mRNA processing: splicing (with example of immunoglobulin heavy or light chain genes) , capping, polyadenylation, coordination of mRNA processing4) rRNA processing: tRNA processing5) Non coding RNAs and their role: RNA interference; siRNA, micro-RNA role in gene silencing, RNA editing <p>References:</p> <ol style="list-style-type: none">1) James D. Watson, Tania Baker, Stephen P. Bell, Alexander Gann, Michael Levine, Richard Loswick (2004) <i>Molecular Biology of the Gene</i>, 5th Edition, Pearson Education, Inc. and Dorling Kindersley Publishing, Inc.2) Lewin's Genes XI, (2014) Jones and Bartelett Publishers Inc.3) Mechanism of subcellular mRNA localization, 2002, CSH, 108, 533-44.4) Micro RNAs in cell proliferation, Cell death and tumorogenesis, B.J. of Cancer, 2006, 94.5) Molecular Biology of the Cell, Bruce Albert et. al. , 6th Edn., Garland Sciences.6) Molecular Biology, Lodish et. al., 7th Edn., W. H. Freeman, 20127) NC RNAs regulations of disease, Taft et. al., J. of Path, 2010, 220, 126-39 Recent progress in structure, Biology and tRNA processing and modification. Mol Cell., 19(2), 2005, 157-668) Concepts of Genetics, W.S. Klug and M.R. Cummings, (2005) Pearson education

Unit 3	<p>Fine Control of Prokaryotic and Eukaryotic translation</p> <ol style="list-style-type: none"> 1) Lactose operon: repressor-operator interactions, mechanism of repression, Positive control of lac operon- Mechanism of CAP action, 2) The Arabinose operon: Ara operon repression loop, evidence for repression loop, auto regulation 3) The trp operon:- control of trp operon by attenuation, defeating attenuation, Riboswitches 4) Sigma factor Switching:- Phage infection- T4,T7 infection in <i>E. coli</i>, SPO1 infection in <i>B. subtilis</i>. 5) Eukaryotic translation: Initiation, elongation and termination <p>References:</p> <ol style="list-style-type: none"> 1) Weaver R., (2007) <i>Molecular Biology</i>, 4th Edition, McGraw Hill Science. 2) Concepts of Genetics, W.S. Klug and M.R. Cummings, (2005) Pearson education
Unit 4	<p>Mobile DNA elements</p> <ol style="list-style-type: none"> 1) Transposable elements in bacteria, IS elements, composite transposons, Integrons. 2) Replicative, nonreplicative transposons, and Mu transposition 3) Controlling elements in Tn A, Tn 5 and Tn 10 transposition 4) Transposons in maize and Drosophila 5) Retroviruses and retrotransposon, Ty elements in yeasts 6) SINES, LINES and Alu elements. 7) Significance of transposons and Integrons. <p>References:</p> <ol style="list-style-type: none"> 1) James D. Watson, Tania Baker, Stephen P. Bell, Alexander Gann, Michael Levine, Richard Loswick (2004) <i>Molecular Biology of the Gene</i>, 5th Edition, Pearson Education, Inc. and Dorling Kindersley Publishing, Inc. 2) Lewin's Genes XI, (2014) Jones and Bartlett Publishers Inc.

MIC5303 MICROBIAL BIOTECHNOLOGY

Unit 1	<p>Microbial Biotechnology and its Applications Microbial biotechnology: Scope and its applications in human therapeutics, agriculture (Biofertilizers, PGPRMycorrhizae), environmental, and food technology Use of prokaryotic and eukaryotic microorganisms in biotechnological applications Genetically engineered microbes for industrial application: Bacteria and yeast</p> <p>References</p> <ol style="list-style-type: none"> 1) Ratledge, C and Kristiansen, B. (2001). Basic Biotechnology, 2nd Edition, Cambridge University Press. 2) Demain, A. L and Davies, J. E. (1999). Manual of Industrial Microbiology and Biotechnology, 2nd Edition, ASM Press. 3) Gupta PK (2009) Elements of Biotechnology 2nd edition, Rastogi Publications 4) Inder AN and Nikaido H (2007) Microbial Biotechnology, 2nd edition, Cambridge University Press
Unit 2	<p>Therapeutic and Industrial Biotechnology</p> <p>Recombinant microbial production processes in pharmaceutical industries - Streptokinase, recombinant vaccines (Hepatitis B vaccine) Microbial polysaccharides and polyesters, Microbial production of bio-pesticides, bioplastics Microbial biosensors</p> <p>References</p> <ol style="list-style-type: none"> 1) Lydersen B., N. a. D' Elia and K. M. Nelson (Eds.) (1993), Bioprocess Engineering: Systems, Equipment and Facilities, JohnWiley and Sons Inc. 2) Operational Modes of Bioreactors, (1992) BIOTOL series, Butterworths Heinemann. Shuichi and Aiba. 3) Biochemical Engineering. Academic Press. 1982 Stanbury and Whittaker. Fermentation technology 4) Swartz, J. R. (2001). Advances in Escherichia coli production of therapeutic proteins. Current Opinion in Biotechnology, 12, 195–201. 5) Prescott, Harley and Klein's Microbiology by Willey JM, Sherwood LM, Woolverton CJ (2014), 9th edition, Mc Graw Hill Publishers.
Unit 3	<p>Applications of recombinant DNA technology – Synthesis of commercial products: Amino acids, ascorbic acid, novel antibiotics, peptide antibodies, biopolymers: gum, rubber, polyhydroxyalkanoates. Unconventional microbial</p>

	<p>systems for production of high quality protein drugs.</p> <p>References</p> <ol style="list-style-type: none"> 1) DubasiGovardhana Rao, 2010 Introduction to BiochemicalEngineering Tata Mcgraw- Hill Education 2) Peter F. Stanbury. Principles Of Fermentation Technology, 2E,Elsevier (A Divisionof Reed Elsevier India Pvt. Limited), 2009 3) Vijai Kumar Gupta, Monika Schmoll, Minna Maki, Maria Tuohy,Marcio Antonio Mazuteditors Applications of MicrobialEngineering. CRC Press 2013 4) Glick BR, Pasternak JJ, and Patten CL (2010) Molecular Biotechnology 4th edition, ASM Press,
<p>Unit 4</p>	<p>Microbial Processes</p> <p>Upstream, Fermentation and Downstream Processing for the following:</p> <ol style="list-style-type: none"> iv. Antibiotics (Rifamycin) ii. Microbial enzymes (Chitinase). iii. Exopolysaccharides (Pullulan) iv. Use of immobilized cells / enzymes to produceprotease <p>References:</p> <ol style="list-style-type: none"> 1) Stanbury PF, Whitaker A, Hall SJ (1995) Principles of Fermentation Technology 2nd edition.,Elsevier Science 2) Crueger W, Crueger A (1990) Biotechnology: A text Book of Industrial Microbiology 2nd edition Sinauer associates, Inc 3) Sudhir U. Meshram, Ganghdhar B Shinde, Applied biotechnology.I.K. International Pvt. Ltd. 2009

**MIC5304: IMUNOLOGY AND MOLECULAR BIOLOGY
(PRACTICALS)**

Unit 1	<p style="text-align: center;">Immunology</p> <ol style="list-style-type: none">1. Precipitation reactions of antigen-antibody: Immuno-electrophoresis – Single radial immunodiffusion and rocket immune-electrophoresis2. Agglutination techniques: Titer determination of isoantibodies to human blood group antigens3. Visit should be organized to research institute for ELISA, ELISPOT assay, Cell cultures, FACS.4. Purification and activity determination of immunoglobulin by dialysis equilibrium technique.
Unit 2	<p style="text-align: center;">Molecular biology</p> <ol style="list-style-type: none">1. Extraction, purification and characterization of plasmid DNA2. Plasmid Curing3. Restriction digestion and ligation of DNA4. Bacterial transformation5. Identification of recombinants by blue and white colony screening

**MIC5305 MICROBIAL BIOTECHNOLOGY AND FOOD TECHNOLOGY
(PRACTICAL)**

Unit 1	Microbial Biotechnology <ol style="list-style-type: none">1. Study of yeast cell immobilization by sodium alginate method2. Pigment production from fungi(Melanin production from <i>Aspergillus fumigatus</i>)3. Isolation of xylanase or lipase producing bacteria4. Study of algal Single Cell Proteins.
Unit 2	Food Technology <ol style="list-style-type: none">1. Determination of Ca , Iron , phosphorus and Ash content of food.2. Determination of acid value, saponification value and iodine number of fats.3. Determination of vitamin C by DNPH method4. Production of wine from grapes by fermentation5. Food adulteration testing6. Determination of vitamin A by spectrophotometer (in oil samples). <p>References:</p> <ol style="list-style-type: none">1. A Food Technology Lab Manual- Rashida R. and Joy P.P.2. Handbook of fruits science and tech. Salunkhe D.K. and Kadam S.S.3. AOAC International. 2003. Official methods of analysis of AOAC International. 17th Ed. Gaithersburg, MD, USA, Association of Analytical Communities.4. Linden G. 1996. Analytical Techniques for Foods and Agricultural Products

MIC5306 – ELECTIVE COURSE - FOOD TECHNOLOGY

Unit 1	FOOD PRODUCTS TECHNOLOGY <ol style="list-style-type: none">1. Principles of Food Analysis: Types of samples analysed, steps in analysis, choice of methods; sampling procedures, considerations and sample preparation; Evaluation of analytical data – accuracy and precision, sources of errors, specificity, sensitivity and detection limits, regression analysis, reporting results. Analysis of chemical constituents, their characterization and significance- moisture, ash, minerals, lipids, fat, proteins, fibre, titratable acidity, starch, reducing sugars.2. Introduction to food safety and security: Hygienic design of food plants and equipments, Food Contaminants (Microbial, Chemical, Physical), Food Adulteration (Common adulterants), Food Additives (functional role, safety issues)3. Food standards and quality maintenance: FPO, PFA, Agmark, ISI, HACCP, food plant sanitation and cleaning in place (CIP), FAO in India, Technical Cooperation programmes, Bio-security in Food and Agriculture REFERENCES: <ol style="list-style-type: none">1) Post harvest biotechnology of vegetables, Salunkhe D.K. Handbook of fruits science and tech. Salunkhe D.K. and Kadam S.S.2) Food and Packaging Interactions by Risch.S.H. Publisher American chemical society, Washington (1991).3) Cereal Processing and Technology, Gavin Owens4) Rathore,N.S. <i>et al.</i> 2008.Fundamentals of Dairy Technology- Theory & Practices. Himanshu Publ.5) AOAC International.2003. Official methods of analysis of AOAC International. 17th Ed. Gaithersburg, MD, USA, Association of Analytical Communities.6) Linden G. 1996. Analytical Techniques for Foods and Agricultural Products7) The food safety information handbook by Cynthia A. Robert, 2009.
Unit 2	NUTRACEUTICALS <ol style="list-style-type: none">1. Introduction to Nutraceuticals as Science<p>Historical perspective, classification, scope & future prospects. Applied aspects of the Nutraceutical Science. Sources of Nutraceuticals. Relation of Nutraceutical Science with other Sciences: Medicine, Human physiology, genetics, food technology, chemistry and nutrition.</p>

2. Study of various Nutraceuticals

Properties, structure and functions of Glucosamine, Octacosanol, Lycopene, Carnitine, Melatonin. Use of proanthocyanidins, flaxseed oil as Nutraceuticals.

3. Microbial Nutraceuticals

Concept of prebiotics and probiotics - principle, mechanism, production and technology involved, applications - examples of bacteria used as probiotics, use of prebiotics in maintaining the useful microflora - extraction from plant sources.

4. Food as remedies

Nutraceuticals bridging the gap between food and drug, Nutraceuticals in treatment for cognitive decline, Nutraceutical remedies for common disorders like Arthritis, Bronchitis, circulatory problems, hypoglycemia, Nephrological disorders, Liver disorders, Osteoporosis, Psoriasis and Ulcers etc. Brief idea about some Nutraceutical rich supplements e.g. Bee pollen, Caffeine, Green tea, Lecithin, Mushroom extract, Chlorophyll, Kelp and *Spirulina* etc.

REFERENCES:

1. Geoffrey P. Webb. 2006. Dietary supplements and functional foods. Blackwell Publishing.
2. Losso, JN. 2007. Anti-angiogenic functional and medicinal foods. CRC Press.
3. Cupp, J and Tracy, TS. 2003. Dietary supplements: Toxicology and Clinical Pharmacology. Humana Press.
4. Manson, P. 2001. Dietary supplements (2nd Ed) Pharmaceutical Press.
5. Campbell, JE and Summers, JL. 2004. Dietary Supplement Labeling Compliance.
6. Shi, J. 2007. Functional Food Ingredients and Nutraceuticals: Processing Technologies. Taylor & Francis Publ. CRC Press.
7. Goldberg, I 1994. Functional Foods: Designer Foods, Pharma foods, Nutraceuticals Chapman & Hall.

MIC5307 ELECTIVE COURSE -IPR BIOSAFETY AND BIOETHICS (ELECTIVE)

Unit 1	<p>Introduction to Intellectual property</p> <ol style="list-style-type: none">1. Introduction and the need for intellectual property right (IPR)2. Types of intellectual property rights3. International organizations - World Intellectual Property Organisation (WIPO)4. IPR in India & abroad5. Some important examples of IPR <p>Patents</p> <ol style="list-style-type: none">1. Introduction & foundation of patent laws2. The different layers of the international patent system (national, regional and international options)3. Patent document4. Searching, drafting and filing of a patent5. Ownership rights and transfer of patent <p>Copyright</p> <ol style="list-style-type: none">1. Concept of copy right2. Copyright Act of 19573. Originality of material & rights of reproduction <p>Trademarks</p> <ol style="list-style-type: none">1. Concept of trademark2. Types of trademark3. Protection & registration of trademark4. Indian trademark law & trademark act of 1999 <p>References:</p> <ol style="list-style-type: none">1. P.N. Cheremisinoff, R.P. Ouellette and R.M. Bartholomew, Biotechnology Applications and Research, Technomic Publishing Co., Inc. USA, 19852. D. Balasubramaniam, C.F.A. Bryce, K. Dharmalingam, J. Green and K. Jayaraman, Concepts in Biotechnology, University Press (Orient Longman Ltd.), 20023. Bourgagaize, Jewell and Buiser, Biotechnology: Demystifying the Concepts, Wesley Longman, USA, 2000.4. Ajit Parulekar and Sarita D' Souza, Indian Patents Law – Legal & Business Implications; Macmillan India Ltd, 20065. B.L. Wadehra; Law Relating to Patents, Trade Marks, Copyright, Designs & Geographical Indications; Universal law Publishing Pvt. Ltd., India 20006. P. Narayanan; Law of Copyright and Industrial Designs; Eastern law House, Delhi, 2010
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Unit 2	<p>Bioethics and biosafety</p> <p>Bioethics</p> <ol style="list-style-type: none"> 1. Concept of ethics and bioethics with respect to microbiological and biotechnological research 2. Social and ethical issues 3. Principles of bioethics. 4. Ethical conflicts in microbiological and biotechnological research 5. interference with nature 6. bioethics vs business ethics. <p>Biosafety</p> <ol style="list-style-type: none"> 1. Definition and importance of biosafety- individuals, institutions, society, region, country and world 2. laboratory associated infections and hazards 3. Bio safety regulation: handling of recombinant DNA products and process in industry and in institutions 4. Organizations involved in biosafety activities 5. Cross border movement of germplasm <p>References:</p> <ol style="list-style-type: none"> 1. Biotechnology: A comprehensive treatise (Vol. 12). Legal economic and ethical dimensions VCH. (2nded) ISBN- 10 3527304320. 2. Encyclopedia of Bioethics 5 vol set, (2003) ISBN-10: 0028657748.Thomas, J.A., Fuch, R.L. (2002). Biotechnology and safety Assessment (3rd Ed) Academic press.
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MIC5308 ELECTIVE COURSE CLINICAL RESEARCH

Unit 1	<p>1. Introduction to clinical research Definition, Types and Scope of Clinical Research, Good Clinical Practices, Drug Development Process, Careers in Clinical Research</p> <p>2. Ethics in clinical research Ethical Theories and Foundations, Ethics Review Committee and Informed Consent Process, Integrity & Misconduct in Clinical Research, Conflicts of Interest</p> <p>3. Regulations in clinical research Evolution and History of Regulations in Clinical Research, Patents US Regulatory Structure, IND, NDA, ANDA, Post Drug Approval Activities, PMS, FDA Audits and Inspections EURegulatory Affairs, EMEA Organization and Function, INDIAN Regulatory system, Schedule Y; Rules and Regulations</p> <p>4. Clinical research methodology Designing of Protocol, CRF, eCRF, IB, ICF, SOP Pharmacoepidemiology, BA/BE Studies Report writing, Publication</p> <p>1.Selected regulations and guidance for drug studies.ICH guidelines 2.Reference guide- popular FDA regulations in clinical research. 3.Clinical research dictionary and introduction to the FDA drug approval process.FDA publication</p>
Unit 2	<p>1. Clinical research management Preparation of a successful clinical study, Study management, Project management Documentation, Monitoring, Audits and Inspections Pharmacovigilance Training in clinical research Budgeting in clinical research, Supplies and vendor management</p> <p>2. Biostatistics and data management Importance of statistics in clinical research Statistical considerations at the design, analysis and reporting stage. Data management, Data validation, SAE reconciliation, query management Software considerations</p> <p>1. Bioequivalence trials- A.wang,r.Arezina, A.Bakhai 2006,richmondpharmacology.com</p> <p>2. Protocol Development- U.Mallick, R.Arezina, C.Ritchie- A practical guide to design 2006.academia.edu</p>

MIC5309 ELECTIVE (PROTEOMICS AND GENOMICS)

Unit 1	<p>Proteomics</p> <ol style="list-style-type: none">1. Expression, Analysis and Characterization of Protein.2. Analysis of protein structure3. Protein interaction.4. Metabolomics and global biochemical networks <p>References:</p> <ol style="list-style-type: none">1. Lewin's Genes XI, (2014) Jones and Bartlett Publishers Inc.2. S.B Primrose and R M Twyman 2006 7th edition. Blackwell publishing Discovering genomics, Proteomics and Bioinformatics, Malom Campbell and L. J. Heyer 2nd Edn., Pearson Publication, 2009.3. James D. Watson, Tania Baker, Stephen P. Bell, Alexander Gann, Michael Levine, Richard Loswick (2004) <i>Molecular Biology of the Gene</i>, 5th Edition, Pearson Education, Inc. and Dorling Kindersley Publishing, Inc.4. Walker J.M., Rapley R. (eds.) <i>Molecular Biology and Biotechnology</i>, 4th Ed., 2009, Royal Society Press, U.K.5. Principles and applications of recombinant DNA, B. R. Glick, J.J. Pasternack, 3rd Edn., ASM press
Unit 2	<p>Genomics</p> <ol style="list-style-type: none">1. Gene sequencing2. conserved genes3. finding base sequences which form genes4. many proteins from one gene,5. Genomic variation-SNPs, SNPS and diseases, SNPS and medical therapies6. Role of genomic variation in nagging7. Costs of prolonged life8. Recognition of trades offs associated with genomic variation.9. Eucaryotic and bacterial SNPS and pharmacogenomics <p>References:</p> <ol style="list-style-type: none">3) Weaver R., (2007) <i>Molecular Biology</i>, 4th Edition, McGraw Hill Science.4) Concepts of Genetics, W.S. Klug and M.R. Cummings, (2005) Pearson education5) S.B Primrose and R M Twyman 2006 7th edition. Blackwell publishing Discovering genomics, Proteomics and Bioinformatics, Malom Campbell and L. J. Heyer 2nd Edn., Pearson Publication, 2009

Deccan Education Society's
FERGUSSON COLLEGE, PUNE
(AUTONOMOUS)

M.Sc. II Microbiology syllabus

SEMESTER – IV

Academic Year 2017-2018

MIC5401 PHARMACEUTICAL MICROBIOLOGY

Unit 1	<p>Drug Discovery and Development:</p> <ol style="list-style-type: none">1. Contributions and postulates of Paul Ehrlich2. Significance of terms - Lead compound, Lead optimization, Candidate selection <p>Drug Discovery:</p> <p>A. Conventional Process Bio-prospecting (Medicinal Chemistry) –</p> <ol style="list-style-type: none">1. Extraction and purification principles,2. Purification and characterization of bioactive molecules from natural sources <p>B. Rational Drug Design –</p> <ol style="list-style-type: none">1. Principle (Structure activity relationship -SAR) and Tools (applications of High Through Put Screening, Combinatorial synthesis, Pharmacogenomics) <p>References:</p> <ol style="list-style-type: none">1. Agarwal S. S. and Paridhavi M., (2007), <i>Herbal Drug Technology</i>, Universities Press (India) Pvt. Ltd2. Altreuter D., and D S. Clark, (1999), <i>Combinatorial Biocatalysis: Taking the Lead From Nature</i>, Curr. Opin. Biotechnol. 10, 130.3. Burn J. H. (1957) <i>Principles of Therapeutics</i>, Blackwell Scientific Pub. O. Ltd. Oxford.4. Chatwal G. P. (2003) <i>Bio-pharmaceutics and Pharmacokinetics</i>, Himalaya Publishing House, Mumbai.5. Paul W. Erhardt, (2006), <i>Medicinal Chemistry in the New Millennium: A Glance into the Future</i>, Ed. ChorghadeMukund S. in Drug discovery and development Volume I: Drug Discovery, Wiley-Interscience, John Wiley and Sons Inc. USA, 17-102.6. Dewick Paul M., (2002), <i>Medicinal natural products: A biosynthetic approach</i>, 2nd Ed., John Wiley and Sons7. Iyengar M. A. (1974) <i>Pharmacology of Powdered Crude Drugs</i>, ManipalMicheles P. S., Y. L. Khmel'nitsley, J. S. Dordick and D. S. Clark,(1998), <i>Combinatorial Biocatalysis, A Natural Approach to Drug Discovery</i>, Trends in Biotechnol. 16, 197.8. Satoskar R. S. & S. D. Bhandarkar (1991) <i>Pharmacology and Pharmacotherapeutics</i>, 12th Ed., Vol. 1 & 2, Popular Prakashan, Mumbai.
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Unit 2	<p>B. Drug Development</p> <ol style="list-style-type: none"> 1. Preclinical development: Toxicity testing – acute, sub-acute and chronic toxicity 2. Clinical development: Clinical trials – (Aims, Objectives, Conduct): I, II, III and IV 3. Drug development: ADME and ADR 4. Role of FDA in drug development (INDA, NDA) <p>References:</p> <ol style="list-style-type: none"> 1. Burn J. H. (1957) <i>Principles of Therapeutics</i>, Blackwell Scientific Pub. O. Ltd. Oxford. 2. Chatwal G. P. (2003) <i>Bio-pharmaceutics and Pharmacokinetics</i>, Himalaya Publishing House, Mumbai. 3. Paul W. Erhardt, (2006), <i>Medicinal Chemistry in the New Millennium: A Glance into the Future</i>, Ed. ChorghadeMukund S. in Drug discovery and development Volume I: Drug Discovery, Wiley-Interscience, John Wiley and Sons Inc. USA, 17-102. 4. Dewick Paul M., (2002), <i>Medicinal natural products: A biosynthetic approach</i>, 2nd Ed., John Wiley and Sons 5. Graly John O. and Pieter H. Joubert, (1997), <i>Handbook of Phase I / II clinical drug trials</i>, CRC Press 6. Satoskar R. S. & S. D. Bhandarkar (1991) <i>Pharmacology and Pharmacotherapeutics</i>, 12th Ed., Vol. 1 & 2, Popular Prakashan, Mumbai. 7. Vyas S. P and Dixit V. R. (2002), <i>Pharmaceutical Biotechnology</i>, CBS Publishers and Distributors, New Delhi <i>Biotechnology</i>, CBS Publishers and Distributors, New Delhi
Unit3	<p>Discovery of anti-infectives</p> <p>A.Evaluation and mechanism determination of anti-infectives using biochemical and microbiological techniques.</p> <ol style="list-style-type: none"> 1. Direct counts (Counting chambers, calibrated smears, proportionate counts), 2. Tubidometry and nephelometry, 3. Electrical Resistance, Electrical impedance, 4. Microcalorimetry 5. Flow cytometry 6. Radiometric methods 7. Radiolabelling techniques <p>B. Laboratory methods to assess activity of antimicrobial combinations</p> <ol style="list-style-type: none"> 1. Antagonism, 2. Synergism <p>References:</p> <ol style="list-style-type: none"> 1. Franklin T. J. and Snow G. A., (1975), <i>Biochemistry of Antimicrobial Action</i>, Chapman and Hall, London, 1-22 and 160- 174 2. Kavanagh Frederick, (1963), <i>Analytical Microbiology Volume I and II</i>, Academic Press, London 3. Lorian V., (1986), <i>Antibiotics in laboratory medicine</i>, 2nd Ed, Williams & Wilkins Publication

	<ol style="list-style-type: none"> 4. Sylvie E. Blondelle, Enrique Pe´Rez-Paya, And Richard A. Houghten, (1996), <i>Synthetic Combinatorial Libraries: Novel Discovery Strategy for Identification of Antimicrobial Agents</i>, 5. Antimicrobial Agents and Chemotherapy, 1067–1071 6. Vyas S. P and Dixit V. R. (2002), <i>Pharmaceutical Biotechnology</i>, CBS Publishers and Distributors,
Unit 4.	<p>Quality Assurance and Validation in Pharmaceutical Industry</p> <ol style="list-style-type: none"> 1. Good Manufacturing Practices (GMP) and Good Laboratory Practices (GLP) in pharmaceutical 2. Industry. 3. Quality assurance and quality management in pharmaceuticals ISO, WHO and US certification. 4. Safety in microbiology laboratory. 5. Biopharmaceuticals –Regulations and Sources: Regulatory authorities and its role: FDA and Pharmacopeia (IP, UK, US) 6. Drug formulations - Carriers and delivery systems, targeted drug delivery, sustained release 7. Pharmacokinetic – ADME / Bioavailability studies <p>References:</p> <ol style="list-style-type: none"> 1. Kokate C. K., Purohit A. P., Gokhale A. B. (2000) <i>Pharmacology</i>, 4th Ed., NiraliPrakashan. 2. Mannfred A. Holliger, (2008), <i>Introduction to pharmacology</i>, 3rd Ed., CRC Press 38 3. Maron Dorothy M. and Bruce N. Ames, (1983), <i>Revised methods for the Salmonella mutagenicity test</i>, Mutation Research, 113:173-215 4. MAron Dorothy M. and Bruce N. Ames, (1983), <i>Revised methods for the Salmonella mutagenicity test</i>, Mutation Research, 113:173-215 5. OsolArther (1975) <i>Remington’s Pharmaceutical Sciences</i>, 15th Ed., Mack Pub. Co., Pennsylvania. 6. Sylvie E. Blondelle, Enrique Pe´Rez-Paya, And Richard A. Houghten, (1996), <i>Synthetic Combinatorial Libraries: Novel Discovery Strategy for Identification of Antimicrobial Agents</i>, 7. Antimicrobial Agents and Chemotherapy, 1067–1071 8. Micheles P. S., Y. L. Khmel’nitsley, J. S. Dordick and D. S. Clark,(1998), <i>Combinatorial Biocatalysis, A Natural Approach to Drug Discovery</i>, Trends in Biotechnol. 16, 197.

MIC5402 APPLIED MOLECULAR BIOLOGY

Unit 1	<p>Gene technology</p> <ol style="list-style-type: none"> 1. Gene cloning strategies: preparation of gene, genome libraries, cDNA libraries, Library screening 2. Site directed mutagenesis and protein engineering, 3. Cloning and manipulating large fragments of DNA ; YAC BAC HAC 4. Transfer of modified genes to host cells; example of insulin gene, factor VIII gene 5. Expression vectors; lac Z construct 6. Ti plasmids and its applications 7. Gene augmentation, Gene therapy <p>References:</p> <ol style="list-style-type: none"> 6. James D. Watson, Tania Baker, Stephen P. Bell, Alexander Gann, Michael Levine, Richard Loswick (2004) <i>Molecular Biology of the Gene</i>, 5th Edition, Pearson Education, Inc. and Dorling Kindersley Publishing, Inc. 7. Lewin's Genes XI, (2014) Jones and Bartlett Publishers Inc. 8. S.B Primrose and R M Twyman 2006 7th edition. Blackwell publishing Discovering genomics, Proteomics and Bioinformatics, Malom Campbell and L. J. Heyer 2nd Edn., Pearson Publication, 2009. 9. James D. Watson, Tania Baker, Stephen P. Bell, Alexander Gann, Michael Levine, Richard Loswick (2004) <i>Molecular Biology of the Gene</i>, 5th Edition, Pearson Education, Inc. and Dorling Kindersley Publishing, Inc. 10. Walker J.M., Rapley R. (eds.) <i>Molecular Biology and Biotechnology</i>, 4th Ed., 2009, Royal Society Press, U.K. 11. Principles and applications of recombinant DNA, B. R. Glick, J.J. Pasternack, 3rd Edn., ASM press. 12. Weaver R., (2007) <i>Molecular Biology</i>, 4th Edition, McGraw Hill Science. 13. Concepts of Genetics, W.S. Klug and M.R. Cummings, (2005) Pearson education
Unit 2	<p>Transgenic plants and animals</p> <ol style="list-style-type: none"> 1. Genetically modified organisms- social and ethical issues 2. Transgenic animals and their applications in medicine – prevention, early detection and cure of diseases 3. Transgenic plants : and their applications in agriculture 4. examples of transgenic plants and animals: advantages and disadvantages 5. Producing useful molecules examples <p>References:</p> <ol style="list-style-type: none"> 1. S.B Primrose and R M Twyman 2006 7th edition. Blackwell publishing Discovering genomics, Proteomics and Bioinformatics, Malom Campbell and L. J. Heyer 2nd Edn., Pearson Publication, 2009.

	<ol style="list-style-type: none"> 2. James D. Watson, Tania Baker, Stephen P. Bell, Alexander Gann, Michael Levine, Richard Loswick (2004) <i>Molecular Biology of the Gene</i>, 5th Edition, Pearson Education, Inc. and Dorling Kindersley Publishing, Inc. 3. Walker J.M., Rapley R. (eds.) <i>Molecular Biology and Biotechnology</i>, 4th Ed., 2009, Royal Society Press, U.K. 4. Principles and applications of recombinant DNA, B. R. Glick, J.J. Pasterneck, 3rd Edn., ASM press.
Unit 3	<p>Genome projects</p> <ol style="list-style-type: none"> 1. Concept and meaning of genome projects and their applications. 2. Introduction to Genome projects of <i>E. coli</i> yeast, Plasmodium, Fruit fly, Mouse, Drosophila, and Rice and comparative genomics 3. Gene annotation <ol style="list-style-type: none"> a. Human Genome project and its applications. <p>References:</p> <ol style="list-style-type: none"> 1. S.B Primrose and R M Twyman 2006 7th edition. Blackwell publishing <i>Discovering genomics, Proteomics and Bioinformatics</i>, Malom Campbell and L. J. Heyer 2nd Edn., Pearson Publication, 2009. 2. James D. Watson, Tania Baker, Stephen P. Bell, Alexander Gann, Michael Levine, Richard Loswick (2004) <i>Molecular Biology of the Gene</i>, 5th Edition, Pearson Education, Inc. and Dorling Kindersley Publishing, Inc. 3. Walker J.M., Rapley R. (eds.) <i>Molecular Biology and Biotechnology</i>, 4th Ed., 2009, Royal Society Press, U.K. 4. Principles and applications of recombinant DNA, B. R. Glick, J.J. Pasterneck, 3rd Edn., ASM press.
Unit 4	<p>Techniques in Molecular biology and diagnostic applications</p> <ol style="list-style-type: none"> 1. PCR and its modifications, nested PCR, Hot start PCR, Reverse transcriptase based PCR (RT –PCR) and Real time PCR (Q –PCR) 2. DNA microarray and its applications 3. Molecular diagnostic tools in detection of cancer. 4. Activity gel assay 5. ChIP 6. RFLP 7. Designing and detection of probe 8. Knockout mice 9. Phage expression system 10. Yeast two and three hybrid assay 11. Measuring transcription rates <p>References:</p> <ol style="list-style-type: none"> 1. S.B Primrose and R M Twyman 2006 7th edition. Blackwell publishing

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| | <ol style="list-style-type: none">2. James D. Watson, Tania Baker, Stephen P. Bell, Alexander Gann, Michael Levine, Richard Loswick (2004) <i>Molecular Biology of the Gene</i>, 5th Edition, Pearson Education, Inc. and Dorling Kindersley Publishing, Inc.3. Walker J.M., Rapley R. (eds.) <i>Molecular Biology and Biotechnology</i>, 4th Ed., 2009, Royal Society Press, U.K.4. Principles and applications of recombinant DNA, B. R. Glick, J.J. Pasternack, 3rd Edn., ASM press.5. Malom Campbell and L. J. Heyer, <i>Discovering genomics, proteomics and bioinformatics</i>, 2nd Edition., Pearson publication, 2009 |
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MIC5403 BIOPROCESS DEVELOPMENT

Unit 1	<p>Bioreactor design and operation</p> <ol style="list-style-type: none"> 1. Designing of bioreactors - Design aspects STRs: The dimensional ratios of the outer shell, and the operational aspects such as working volume, baffles and impellers. 2. The configuration (placement) of impellers in a vessel and the different types of impellers (types of turbines and propellers, and their combinations) 3. Immobilized cell reactors and air-lift reactors – Design and operation. 4. Batch, Fed-batch and Continuous operation: Applications, advantages and limitations of each type <p>References</p> <ol style="list-style-type: none"> 1. Doran Pauline (1995) Bioprocess Engineering Principles, Academic Press. 2. Lydersen B., N. a. D' Elia and K. M. Nelson (Eds.) (1993) Bioprocess Engineering: Systems, Equipment and Facilities, John Wiley and Sons Inc. 3. Ratledge C and Kristiansen B eds. (2001) Basic Biotechnology 2nd Ed. Cambridge Univ. Press.
Unit 2	<p>Process Variables</p> <ol style="list-style-type: none"> 1. Aeration - Theory of oxygen transfer in bubble aeration, Oxygen transfer kinetics (Oxygen Uptake Rate –OUR; Oxygen Transfer Rate OTR; Ccrit), determination of KLa. 2. Agitation - Functions of agitation. Flow patterns with different types of impellers. 3. Fermentation broth rheology and power requirements for agitation – Concept of Newtonian and non-Newtonian fluids, effect of broth rheology on heat, nutrient and oxygen transfer, Reynold's number, Power number, Aeration number: working out examples 4. Use of various types of sensors and biosensors for monitoring environmental parameters (pressure, pH, temperature, DO and DCO₂), Basic principles of operation, types of biosensors. <p>References</p> <ol style="list-style-type: none"> 1. Lydersen B., N. a. D' Elia and K. M. Nelson (Eds.) (1993), Bioprocess Engineering: Systems, Equipment and Facilities, John Wiley and Sons Inc. 2. Operational Modes of Bioreactors, (1992) BIOTOL series, Butterworths Heinemann. 3. Shuichi and Aiba. Biochemical Engineering. Academic Press. 1982 4. Stanbury and Whittaker. Fermentation technology

<p>Unit 3</p>	<p>Microbial Growth characteristics and product formation</p> <ol style="list-style-type: none"> 1. Concept of primary (growth associated) and secondary (growth non-associated) metabolites and their control, 2. Kinetics of growth and product formation (growth rate, yield coefficient, efficiency etc.) 3. Effect of type of growth on fermentation: The type of growth (mycelial pellet form, mycelial filamentous form, free cell, cells producing exopolysaccharides) affects mass transfer of nutrients, oxygen and heat; as also cell proliferation can be affected by shearing of cells. At least one example of each type may be explained to show these effects in any suitable fermentation. <p>References</p> <ol style="list-style-type: none"> 1. Dubasi Govardhana Rao, Rao 2010 Introduction to Biochemical Engineering Tata Mcgraw- Hill Education 2. Peter F. Stanbury. Principles Of Fermentation Technology, 2E, Elsevier (A Division of Reed Elsevier India Pvt. Limited), 2009 3. Vijai Kumar Gupta, Monika Schmoll, Minna Maki, Maria Tuohy, Marcio Antonio Mazutt editors Applications of Microbial Engineering. CRC Press 2013
<p>Unit 4:</p>	<p>Use of fungi in industry</p> <ol style="list-style-type: none"> 1. Food industry, biosensors and fuel cells (Architecture of the fungal cell: cell wall, membranes and cytoskeleton) 2. Use of fungi in agriculture and environmental applications: <ol style="list-style-type: none"> i. Biofertilizers, Bioremediation and Biological control. ii. Food industry, biosensors and fuel cells <p>References:</p> <ol style="list-style-type: none"> 1. C.S.K. Mishra, Ed., Pascale Champagne Associate editor, Biotechnology applications. I.K. International Pvt. Ltd. 2009 2. Dilip K. Arora editor, Fungal Biotechnology in agricultural, food and environmental applications (Mycology), 2005. Marcel Dekker, Inc. New York. Basel 3. Sudhir U. Meshram, Gangadhar B Shinde, Applied biotechnology. I.K. International Pvt. Ltd. 2009

**MIC5404 BIOPROCESS DEVELOPMENT AND PHARMACEUTICAL
MICROBIOLOGY**

(PRACTICAL)

Unit 1	<p>Experiments based on bioprocess development</p> <ol style="list-style-type: none">1. Strain improvement study2. Study of rheological changes of broth due to fungal growth3. Recovery and purification of fermentation products-enzymes, antibiotics, organic acids, alcohol, exopolysaccharide4. Scale up from flask to lab fermenter
Unit 2	<p>Experiments based on pharmaceutical microbiology</p> <ol style="list-style-type: none">1. Extraction of bioactive principles from plant and activity fractionation and preparative TLC. IR analysis of the bioactive molecule.2. Estimation of its antimicrobial activity using standard guidelines (CLSI)3. Toxicity testing of the chemical compounds (EtBr) or Drug. Renal toxicity, Carcinogenicity. (Demonstration) <p>Referenes:</p> <ol style="list-style-type: none">1. Improving industrial yeast strains.Jan Steensels Tim Snoek.FEMS Micobiology Reviews.Vol.38 Issue5 Sept2014,947-995

**MIC5405 DEVELOPMENTAL BIOLOGY, MICROBIAL ECOLOGY &
WASTEWATER TREATMENT**

(Practical)

Unit 1	<ol style="list-style-type: none"> 1. Demonstration of mounting of embryos of frog at various developmental stages on permanent slides 2. Mounting of embryos of fruitfly at various developmental stages
Unit 2	<ol style="list-style-type: none"> 1. Estimation of pollution load of a natural sample (e.g. river water) 2. Setting up of a laboratory experiment to assess degradability of synthetic wastewater\ 3. Solid waste management by composting/ vermicomposting. Comparison of various parameters with commercially available compost
	<p>References:</p> <ol style="list-style-type: none"> 1. Gibert Scott F. (2003). <i>Developmental Biology</i>. 7th Ed. Sinauer Associates Inc. Mass. USA. 2. Muller W.A. (1997) <i>Developmental Biology</i>, SpringerVerlag, New York, Inc. 3. Wolpert Lewis (1998) <i>Principles of Developmen</i>. Oxford University Press Oxford 4. <i>Standard Methods for the Examination of Water and Wastewater</i> (2005) 21st edition, Publication of the American Public Health Association (APHA), the American Water Works Association (AWWA), and the Water Environment Federation (WEF); edited by Andrew D. Eaton, Mary Ann H. Franson. 5. Tchobanoglous G. and F. L. Burton. (1991). <i>Wastewater Engineering, Treatment, Disposal and Reuse</i>. 3rd Ed., Metcalf and Eddy (Eds). Tata Mac Graw Hill Publishing Co. Ltd. New Delhi

MIC5406 ELECTIVE COURSE ON DEVELOPMENTAL BIOLOGY

Unit 1	Basic principles of developmental biology <ol style="list-style-type: none">1. Concept and principles of developmental biology,2. Hox code in different systems, Morphogen gradients, Apoptosis and PCD pathways3. Signal transduction pathways in PCD Changes in membrane architecture in PCD.4. Homeostasis and its significance in biological systems. Types of rhythms: Circadian and other examples.5. Types of cleavages and their presence in biological systems. Differentiation, trans-differentiation and de-differentiation
Unit 2	Development in <i>Drosophila</i> and <i>Xenopus</i> <ol style="list-style-type: none">1. <i>Drosophila</i>: Fertilization, blastulation and gastrulation events, segmentation details of events.2. <i>Xenopus</i>: Fertilization and control over the process of fertilization, organizer and its significance, blastulation, epiboly, invagination and gastrulation events.
	References <ol style="list-style-type: none">1. Gilbert Scott F. (2003). Developmental Biology. 7th Ed. Sinauer Associates Inc. Mass. USA.2. Muller W.A. (1997) Developmental Biology, SpringerVerlag, New York, Inc.3. Wolpert Lewis (1998) Principles of Development. Oxford University Press Oxford

MIC5407 ELECTIVE COURSE ON MICROBIAL ECOLOGY

Unit 1	<ol style="list-style-type: none"> 1. Interactions between environment and biota 2. Aut- and synecology of macro- and microorganisms: definitions, terminology, concepts 3. Concept of habitat and ecological niches : niche width and overlap; fundamental and realized niche 4. Community ecology: Nature of communities, community structure and attributes, levels of species diversity and its measurement; edges and ecotones 5. Ecological succession: types and mechanisms of succession and concept of climax 6. Species interactions: Plant-animal interactions; mutualism, commensalism, competition and predation; trophic interactions
Unit 2	<ol style="list-style-type: none"> 1. Applied Ecology: Environmental pollution, global environmental change, biodiversity status, monitoring and documentation, major drivers of biodiversity change, biodiversity management approaches 2. Ecology of natural ecosystems: marine ecosystems (oceans, estuaries), freshwater ecosystems (rivers, lakes, swamps), terrestrial ecosystems (rocks and soil, tundra) 3. Biogeochemical cycles: Microbial engines of the earth system
	<p>References:</p> <ol style="list-style-type: none"> 1. Dash, M.C. (1993). Fundamentals of Ecology. Tata McGraw Hill Publishing Hill Co. Ltd., New Delhi 2. Macan, T. T. (1974). Freshwater Ecology. Longman Group Ltd., London 3. Meadows, P. S. and Campbell. (1978). An introduction to Marine Science. Blackie and Sons Ltd., Glasgow. 4. Richards, B. N. (1987). Microbiology of Terrestrial Ecosystems. Longman Scientific and Technical, N.Y. 5. Madigan et al. (2011). Brock Biology of Microorganisms, 13th ed. Pearson 6. Falkowski et al (2008). The microbial engines that drive Earth's biogeochemical cycles

MIC5408 ELECTIVE COURSE ON WASTE WATER

Unit 1	<p>Principles of Wastewater Treatment</p> <ol style="list-style-type: none"> 1. The need for Wastewater Treatment 2. Different constituents of waste water and their assessment methods to check treatment efficacy Effluent disposal, control and reuse. 3. Water pollution control, Regulation and limit for disposals in the lakes, rivers, oceans, and land. Direct and indirect reuse of treated effluents and solid wastes <p>Pretreatment & Primary treatment process (Unit Processes)</p> <ol style="list-style-type: none"> 1. Layout of typical wastewater treatment plants 2. Introduction and significance of - <ul style="list-style-type: none"> • Flow equalization • Screening • Flocculation • Flotation • Granular medium filtration
Unit 2	<p>Secondary and Tertiary Treatment process (Unit Processes)</p> <ol style="list-style-type: none"> 1. Biological Processes (Aerobic, Anaerobic, Combined).Different types of reactors used in these processes 2. Introduction and significance of - <ul style="list-style-type: none"> • Sedimentation and clarification • Disinfection and dechlorination • Adsorption 1. Sludge treatment and disposal 2. Treatment of Industrial waste water containing biodegradable and nonbiodegradable constituents.(one industry of each type)

References:

1. Biotechnology for Water and Wastewater Treatment. Dr. SatyaPrakash. Navyug Publishers & Distributors, New Delhi. 2009.
2. Industrial Water Pollution Control. 3rd Edition. W. Wesley Eckenfelder Jr. McGraw Hill. 2000. Standard Methods for the Examination of Water & Wastewater. 21st Edition. 2005.APHA.AWWA.WEF
3. Tchobanoglous G. and F. L. Burton. (1991). *Wastewater Engineering, Treatment, Disposal and Reuse*. 3rd Ed., Metcalf and Eddy (Eds). Tata Mac Graw Hill Publishing Co. Ltd. New Delhi
4. *Disposal and Reuse*. 3rd Ed., Metcalf and Eddy (Eds). Tata Mac Graw Hill Publishing Co. Ltd. New Delhi
5. Tchobanoglous G. and F. L. Burton. (1991). *Wastewater Engineering, Treatment,*
6. *Wastewater Treatment and Technology*. Christopher Forster. Thomas Telford

MIC5409 Elective course on Applications of rDNA technology

	Topics
Unit1	<p>Transgenic plants and animals</p> <ol style="list-style-type: none">1. Genetically modified organisms- social and ethical issues2. Transgenic animals and their applications in medicine – prevention, early detection and cure of diseases3. Transgenic plants : and their applications in agriculture4. examples of transgenic plants and animals: advantages and disadvantages5. Producing useful molecules examples <p>References:</p> <ol style="list-style-type: none">5. Walker J.M., Rapley R. (eds.) Molecular Biology and Biotechnology, 4th Ed., 2009, Royal Society Press, U.K.6. Principles and applications of recombinant DNA, B. R. Glick, J.J.Pasterneck, 3rd Edn., ASM press.
Unit 2	<p>Bioremediation and Biomass utilization</p> <ol style="list-style-type: none">1. Degradation of xenobiotics, engineered degradative pathways.2. Utilization of starch and cellulose for fructose, alcohol and silage production <p>References:</p> <ol style="list-style-type: none">1. Walker J.M., Rapley R. (eds.) Molecular Biology and Biotechnology, 4th Ed., 2009, Royal Society Press, U.K.2. Principles and applications of recombinant DNA, B. R. Glick, J.J.Pasterneck, 3rd Edn., ASM press.