



SARDAR PATEL UNIVERSITY, VALLABH VIDYA NAGAR
Syllabus of M.Sc. Biomedical Science, Semester- III
(Effective from Academic Year 2020-21)

PT03CBMC21: Genetic Engineering

Unit-I

Concept and importance of Genetic Engineering; General strategies and Steps involved in gene cloning; Extraction and purification of DNA and RNA from bacteria, virus, plant and animal cells; physical and enzymatic methods for cutting DNA; DNA ligase and other enzymes involved in gene cloning; Construction of genomic and cDNA libraries; Introduction of DNA into host cells; screening and selection methods for recombinant clones.

Unit-II

Cloning vectors- Basic properties and cloning strategies for vectors derived from Plasmids, λ bacteriophages, M-13 phage, Cosmids, Fosmids, Phagemids, Phasmids, YAC, BAC, HAC/MAC and viral vectors for Plant and animal cells.
Salient features of expression vectors for heterologous expression in *E. coli*, Yeast, Insect and Mammalian system, factors influencing heterologous gene expression.

Unit-III

DNA sequencing and sequence assembly: Maxam-Gilbert's and Sanger's methods, Shot gun sequencing, Next generation sequencing strategies for large genomes. DNA mapping and DNA fingerprinting: Physical and molecular mapping, Hybridization and PCR based methods of fingerprinting. Site directed mutagenesis: Methods and applications. Polymerase Chain Reaction: Principle and basic types of PCR; Reverse Transcription and Real Time PCRs.

Unit-IV

Applications of Genetic engineering in improvement of plants, animals and microbes; Gene editing and its applications; Metagenomics and Metabolic engineering; Human disorders and Gene therapy; Gene therapy; Restriction and regulations for the release of GMOs; Biosafety and levels of Physical and Biological containment; The Indian Guidelines for release and use of GM organisms.

Reference Books

- Genome 3rd Edition – Brown
- Molecular Biotechnology – Glick
- Principles of Genetic Manipulation – Old and Primrose
- Applied Molecular Genetics – Roger Miesfeld
- Biotechnology – H. K. Das
- Recombinant DNA – Watson et. al.
- Molecular cloning – Sambrook and Russel
- From genes to clones – Ernst Whittaker

PT03CBMC22: Clinical Biochemistry

Unit-I

Introduction to clinical biochemistry: Sample collection, preservation and transportation (blood, urine, spinal fluid, saliva, synovial fluid, amniotic fluid). Electrolytes and acid-base balance: Regulation of electrolyte content of body fluids and maintenance of pH, reabsorption of electrolytes.

Unit-II

Disorders of Metabolism: Carbohydrate metabolism- DM and GTT, assay of insulin, proinsulin and insulin antibodies, HbA1c, GSD, galactosemia, fructosuria, pentosuria, Lactose intolerance. Hypoglycemia.

Lipid and Lipoprotein Metabolism – atherosclerosis, coronary heart disease, and fatty liver, Taysach's and Niemann Pick diseases. Hyper and hypo lipoproteinemia.

Nucleic acid Metabolism- Hypo and hyper uricemia, gout

Erythrocyte and heme metabolism –Porphyria, hemoglobinopathies, thalassemia, sickle cell anaemia

Protein and amino acid Metabolism- PKU, Tyrosinemia, MSUD, Alkaptonuria, Hartnup's Disease

Unit-III

Diagnostic Enzymes – Enzymes in health and diseases. Biochemical diagnosis of diseases by enzyme assays – SGOT, SGPT, CPK, cholinesterase, LDH. Clinically important isoenzymes e.g. CPK, LDH. Serum protein electrophoresis & clinical interpretation

Blood Clotting – Disturbances in blood clotting mechanisms – haemorrhagic disorders – haemophilia, von Willebrand's disease, purpura, Rendu-Osler-Werber disease, thrombotic thrombocytopenic purpura, disseminated intravascular coagulation, acquired prothrombin complex disorders, circulating anticoagulants

Unit-IV

Function Tests: Renal function tests - urea clearance, creatinine clearance and inulin clearance

tests, PAH, filtration fraction, concentration and dilution tests, 15' - PSP excretion test.

Liver function tests – tests based on excretory metabolic and synthetic functions of liver, serum enzymes.

Gastric function tests – collection of gastric contents, examination of gastric residuum, FTM, stimulation tests, tubeless gastric analysis. Pancreatic function tests.

Thyroid function tests –tests based on blood levels and, metabolic effects of thyroid hormones, tests to detect auto immune diseases of thyroid gland, Radio-iodine uptake studies and turn over studies.

Reference Books

- Tietz Textbook of Clinical Chemistry, Carl A. Burtis, Edward R. Ashwood, Harcourt Brace & Company Aisa Pvt. Ltd.
- Commercial Biosensors: Graham Ramsay, John Wiley & Son, INC. (1998).
- Essentials of Diagnostic Microbiology, Lisa Anne Shimeld. Diagnostic Microbiology, Balley & Scott's. Eleventh Edition.

- Tietz Textbook of Clinical Chemistry and Molecular Diagnostics, 4th Edition By Carl A. Burtis, Edward R. Ashwood, and David E. Bruns,
- The Science of Laboratory Diagnosis, Crocker Burnett.
- Text books of Medical Laboratory Technology – Dr.Praful B. Godkar Henry's Clinical Diagnosis and Management by Laboratory Methods 2 Richard McPherson Matthew Pincus
- Biochemistry for medical students: Vasudeven and Shreekumar Jay pee prakashan. Practical Clinical biochemistry by Harold verly Text book of medical biochemistry by- Chatterjea and Rana Shinde

PT03CBMC23: Nanotechnology and its Applications in Biomedical Science

Unit-I

Introduction to Nano-science and Nano-technology, Nano-scale material, implications for Physics, Chemistry, Engineering & Biology. Classification: Nano-materials, 0D, 1D, 2D structures, Properties of materials & nanomaterials, role of size in nanomaterials, nanoparticles, nanotubes, fullerenes, nanowires, nanoclusters, quantum dots, and enhanced surface activity compared to the same materials in the macroscopic state. . Biomedical applications of Inorganic nanomaterials (Metallic and metal oxides). Nano-Materials in Biosystems: Proteins - Lipids - RNA and DNA etc.

Unit-II

Physical, chemical and biological Methods: Topdown and bottom up approach for building nanomaterials, Methods for synthesis of Nanoparticles for drug delivery (including solid lipid nanoparticles, synthetic and biopolymeric nanoparticles), carbon nanotubes, polymeric nanofibers, Magnetic nanoparticles, Self – assembly structures such as liposomes, micelles, aquasomes and nanoemulsions. Machine-Phase Nanotechnology.

Unit-III

Nanotechnology in Drug Delivery & Therapeutics:Conventional vs Nanosystem based drug delivery,Nanoparticle in Drug delivery- Available applications, Nanotechnology future application understanding for treatment. Manufacture of Drug Delivery Systems, Nanopowder and Nanocrystals, Targeting Ligands Applications of Nanoparticle in Drug Delivery, Cancer Treatment, Nanoparticle Mediated Delivery of siRNA, Nanonephrology, Nanosystems in Inflammation, Targeting Macrophages to Control Inflammation, Tissue Regeneration, Growth And Repair, Tissue Bioengineering; Nanotechnology- Future Understanding for Treatment, Drug Delivery Technology Significance, Impact of Drug Discovery and Development of intelligent drug delivery systems.

Unit-IV

Nanotechnology in Diagnostics:Introduction -Nano diagnostics -Rationale of Nanotechnology for Molecular Diagnostics -Nanoarrays for Molecular Diagnostics. NanoPro™ System -Nanofluidic/Nanoarray Devices to Detect a Single Molecule of DNA-Self Assembling Protein Nanoarrays -Fullerene Photo detectors for Chemiluminescence Detection on Micro fluidic Chips - Protein Microarray for Detection of Molecules with Nanoparticles Protein Nanobiochip Nanoparticles for Molecular Diagnostics -Gold Nanoparticles -Quantum Dots for Molecular Diagnostics Magnetic Nanoparticles -Use of Nanocrystals in Immunohistochemistry -Imaging Applications of Nanoparticles Study of

Chromosomes by Atomic Force Microscopy -Applications of Nanopore Technology for Molecular Diagnostics DNA-Protein and DNA-Nanoparticle Conjugates, other biotransducing mechanism employed in bio-sensing devices.

Reference Books:

- Nanotechnology: Importance and Application by M.H. Fulekar, IK International, 2010.
- Nanotechnology in Biology and Medicine: Methods, Devices and Application by Tuan Vo-Dinh, CRC press, 2007.
- Introduction to Nanotechnology, Charles P. Poole, Jr., Frank J. Owens, Wiley-India
- Nanotechnology: Principles and practices by Sulabha K. Kulkarni, Springer Publication
- Nanotechnology and Drug Delivery Volume one and two: Nanoplatforms in Drug Delivery, Jose L. Arias, CRC press
- Nanocrystals: Synthesis, Properties and Applications, C. N. R. Rao, P. J. Thomas and G.U. Kulakarni, Springer (2007)
- Nanostructures and Nanomaterials: Synthesis, Properties and Application, Guozhong Gao, Imperial College Press(2004)
- Nanosystem characterization tools in the life sciences by Challa Kumar. Wiley-VCH, 2006.
- Introduction to Nanoscience by Gabor L. Hornyak, Joydeep Dutta, Harry F. Tibbals, Anil K. Rao. CRC Press, 2008.
- *The Handbook of Nanomedicine* Kewal K. Jain, Humana Press, (2008).
- *Nanomedicine: A Systems Engineering Approach* Zhang, 1st Ed., Pan Stanford Publishing,
 - (2005).
- *Nanomedicine Volume IIA: Biocompatibility*, Robert A. Freitas Jr., Landes Bioscience Publishers, (2003).

PT03EBMC21: Clinical Pharmacology & Toxicology

Unit-I

Definition and scope of clinical pharmacology: Evaluation of drugs in man, Official regulation of medicines, Classification and naming of drugs; Drug therapy monitoring in special situations such as paediatric geriatric, pregnancy etc; Racial gender and ethnic differences in drugs response; Patient counselling and interviewing techniques, Improving patient compliance and patient monitoring

Unit-II

Development of drug and clinical trials: Development of new drugs, protocol designing, phases, clinical pharmacokinetics and pharmacodynamic studies, therapeutic drug monitoring, pharmacovigilance, Adverse Drug Reaction monitoring, drug utilization studies

Unit-III

Mechanism of action and utility of drug: Essential drug concept and rational prescriptions, Recent advances in understanding of mechanism of drug action and treatment of diseases; new drugs and new uses of old drugs, post marketing surveillance, methodology and ethics of clinical trials, Drug information service, therapeutic audit, GLP, GMP and Good Clinical Practices (GCP).

Unit-IV

Principles of toxicology: Definition, scope and different branches of toxicology. Toxicity tests: acute and chronic toxicity studies (*In situ* implantation, Cytotoxicity, haemolysis, thrombogenic potential test, systemic toxicity, intracutaneous irritation test), sensitization, carcinogenicity and mutagenicity. Applied Toxicology: Biochemical & Immuno-toxicology Toxicogenomics, Toxicoproteomics, Toxicometabolomics

Reference Books

- Tripathi, K. D. Essentials of Medical Pharmacology, Jaypee Brothers Medical Publishers (P) Ltd., 7th Edition
- Brunton, L., Chabner, B., Knollman, B., Goodman and Gilman's The Pharmacological Basis of Therapeutics, McGraw-Hill Professional, 12th edition
- Katzung, B., Masters, S., Trevor, A., Basic and Clinical Pharmacology 12/E (Lange Basic Science Series), McGraw-Hill Medical Publishers, 12th Edition
- Seth, S. D. and Seth, V., Text Book of Pharmacology, Elsevier Publishers
- Brar, F. S. K., Text Book of Pharmacology, S. Chand and Company Limited
- Klaassen, C. D., Casarett and Doull's Toxicology: The Basic Science of Poisons, McGraw-Hill Professional, 7th Edition
- Pillay, V. V., Modern Medical Toxicology, Jaypee Brothers Medical Publishers (P) Ltd., 4th Edition

PT03EBMC22: Bio-safety and IPR

Unit-I

Biotechnology and society: Biotechnology and social responsibility, public acceptance issues in biotechnology, issues of access, ownership, monopoly, traditional knowledge, biodiversity, benefit sharing, environmental sustainability, public vs private funding. Social and ethical issues in Biomedical. Principles of bioethics. Ethical conflicts in Biomedical- interference with nature, unequal distribution of risk and benefits in biomedical science, bioethics vs business ethics. Institutional Animal Ethics Committee (IAEC). Institutional Ethics Committee for Humans.

Unit-II

Bio- safety: Definition of bio-safety, bio-safety concerns at the level of individuals, institutions, society, region, country and world. Bio-safety in laboratory institution: laboratory associated infection and other hazards, assessment of biological hazards and level of biosafety. Bio safety regulation: handling of recombinant DNA products and process in industry and in institutions. Institutional Biosafety Committee.

Unit-III

IPR I: Introduction to IPR: Forms of IPR and Intellectual property protection. Concept of property with respect to intellectual creativity, Tangible and Intangible property. WTO: agency controlling trade among nations, WTO with reference to biotechnological affairs, TRIPs. WIPO, EPO.

Unit-IV

IPR II: Concept related to patents novelty, non-obviousness, utility, anticipation, prior art etc. Type of patents. Indian patent act and foreign patents. Patentability, Patent application, Revocation of patent, Infringement and Litigation with case studies on patent, Commercialization and Licensing. Non-patentable materials.

References Books:

- Fleming, D.A., Hunt, D.L., (2000). Biotechnology and Safety Assessment (3rd Ed) Academic press.
- Thomas, J.A., Fuch, R.L. (1999). Biotechnology and safety assessment (3rd Ed). CRC press, Washington.
- Law and Strategy of biotechnological patents by Sibley. Butterworth publication.(2007)
- Intellectual property rights- Ganguli-Tat McGrawhill. (2001)
- Intellectual Property Right- Wattal- Oxford Publicatiopn House.(1997)
- Biotechnology - A comprehensive treatise (Vol. 12). Legal economic and ethical dimensions VCH. (2nd ed)
- Encyclopedia of Bioethics 5 vol set, (2003)
- Thomas, J.A., Fuch, R.L. (2002). Biotechnology and safety Assessment (3rd Ed) Academic press.
- B.D. Singh. Biotechnology expanding horizons. 10. H.K.Das. Text book of biotechnology 3rd edition.

PT03EBMC23: Methods in Biology

Unit-I

Molecular Biology and r-DNA Methods: Different separation techniques, expression of recombinant proteins using bacterial, animal and plant vectors, DNA sequencing methods, strategies for genome sequencing, isolation, separation and analysis of carbohydrate and lipid molecules; RFLP, RAPD and AFLP techniques

Unit-II

Histochemical and Immunotechniques: Antibody generation, detection of molecules using ELISA, RIA, western blot, immunoprecipitation, flow-cytometry and immunofluorescence microscopy, detection of molecules in living cells, *In situ* localization by techniques such as FISH and GISH

Unit-III

Microscopic techniques: Visualization of cells and subcellular components by light microscopy, resolving powers of different microscopes, microscopy of living cells, Fluorescence microscopy, scanning and transmission microscopes, different fixation and staining techniques for EM, freeze-etch and freeze-fracture methods for EM, image processing methods in microscopy

Unit-IV

Electrophysiological techniques: Single neuron recording, patch-clamp recording, ECG, Brain activity recording (EEG), lesion and stimulation of brain, pharmacological testing, PET, MRI, fMRI, CAT

Reference Books

- Wilson K., Walker J., Principles and Techniques of Biochemistry and Molecular Biology
- Nelson D. L., Cox M. M., Lehninger Principles of Biochemistry, W. H. Freeman; 5th edition

PT03CBMC24: Practical based on PT03CBMC21 and PT03CBMC22

- DNA and RNA isolation
- Estimation of DNA and RNA
- Restriction digestion of the DNA
- Preparation of competent cells and transformation
- DNA ligation
- Estimation of protein by Lowery method
- Estimation of Reducing Sugar by DNS Method
- Estimation of SGOT/SGPT
- Estimation of A/G ratio
- Estimation of serum bilirubin
- Glucose tolerance test
- Qualitative and quantitative analysis Saliva (α -amylase) and Urine
- Separation of amino acids by TLC
- Demonstration of SDS-PAGE of proteins

PT03CBMC25: Practical based on PT03CBMC23 and PT03EBMC21

- Synthesis of various metal nanoparticles.
- Synthesis of transition metal oxide nanoparticles .
- Absorption study of nano-particles using UV-Vis spectroscopy.
- To study colloidal suspension of nanoparticles.
- To determine particle size with zeta potential using DLS.
- Synthesis of micelles and inverse micelles.
- To study the polymer based nanodrug delivery carriers.
- Antibiotic or drug inhibition assays.
- Experiment based on HPLC
- Cell viability assay (Trypan blue assay)
- Apoptosis determination by fluorescent dyes
- DNA fragmentation study by agarose gel electrophoresis
- Enzyme inhibition study at different condition like pH and temperature
- Demonstration of filing a patent
- Various case study related to patent
- Various routes of drug administration

PT03CBMC26: Comprehensive Viva

