Faculty of Engineering & Technology
P.K. University
Shivpuri (MP)

Evaluation Scheme & Syllabus for
M. Tech - (*Bio-Tech Engineering*)
(I to IV Semester)

(Effective from session 2019-20)

EVALUATION SCHEME

M.TECH- *BIO-TECH ENGINEERING*

Semester-I

SUBJECT CODE	SUBJECT NAME	THEORY		PRACTICAL		TOTAL
		SESS. (30)	EXT. (70)	SESS. (25)	EXT .(25)	
MBT-101	ENGINEERING MATHEMATICS	30	70	NA	NA	100
MBT-102	CELL AND MOLECULAR BIOLOGY	30	70	25	25	150
MBT-103	BIOPROCESS ENGINEERING.	30	70	25	25	150
MBT-104	CELL & TISSUE CULTURE	30	70	25	25	150
MBT-105	GENOMICS AND GENETIC ENGG.	30	70	25	25	150

Semester-II

SUBJECT CODE	SUBJECT NAME	THEORY		PRACTICAL		TOTAL
		SESS. (30)	EXT. (70)	SESS. (25)	EXT. (25)	
MBT-201	IPR & BIOSAFETY	30	70	NA	NA	100
MBT-202	BIO-ENTREPRENEURSHIP	30	70	NA	NA	100
MBT-203	IMMUNO-TECHNOLOGY	30	70	25	25	150
MBT-204	STEM CELL TECHNOLOGY	30	70	25	25	150
MBT-205	PROTEOMICS & PROTEIN ENGINEERING	30	70	25	25	150
MTCE-207	SEMINAR-I	NA	NA	25	25	50

Semester-III

SUBJECT CODE	SUBJECT NAME	THEORY		PRACTICAL		TOTAL
		SESS. (30)	EXT .(70)	SESS. (25)	EXT. (25)	
MTCE-301	DISSERTATION PHASE-I	NA	NA	300	300	600
MTCE-302	SEMINAR-II	NA	NA	25	25	50
						650

Semester-IV

SUBJECT CODE	SUBJECT NAME	THEORY		PRACTICAL		TOTAL
		SESS.(30)	EXT. (70)	SESS. (25)	EXT. (25)	
MTCE-401	DISSERTATION PHASE-II	NA	NA	300	300	600
						600

Department Of Bio-Tech Engineering
(Faculty of Engineering & Technology)
P.K. University, Shivpuri (MP)

I Year I Semester
MBT101 - ENGINEERING MATHEMATICS

Module-I

Differentiation; Integration; Maxima and minima; First and second order differentiation; Linear equation with constant and variable coefficient. Probability- Axiomatic definition; Addition theorem; Conditional probability; Bayes' theorem; Random variable; Mathematical expectation; Theoretical distribution- Binomial, Poisson, Normal and Standard normal distribution

Module-II

Statistics- Measures of central tendencies and distribution; Coefficient of variation; Sampling parameter; Static and standard error; Census and Sample methods; Method of sampling

Module-III

Testing of hypothesis; Null and alternative hypothesis; Type I and type II errors; Level of significance; Large sample test; Test of significance of single and two sample means; Test of significance of single and two proportion. Small sample tests- F test; T test (Paired, unpaired); Chi square test goodness of fit.

Module-IV

Correlation (Partial and Multiple correlation); Regression (Sample linear, non linear and multiple Regression); Analysis of variance (One way and Two way).

Module-V

Mole concept, Determination of mole wt. by gram molecular volume relationship, problems based on mole concept, Solutions, colligative properties, Methods of expressing concentrations, strength, Normality, Molarity & Molality, ppm. Standardization of solutions, Colloids, pH, buffer systems, dissociation constant, pK value, Preparation of standard solution of acids and bases, problems related to acid base titrations, volumetric experiments-acidimetry, alkalimetry, permanganometry, dichrometry, iodometry., Methods of plotting Enzyme Kinetics Data, Effects of pH and temperature on Enzyme stability and activity.

Books & References :

1. Jerrold H. Zar. Bio Statistical Analysis, Tan Prints (I) Pvt. Ltd., New Delhi, New Edition.
2. B.S. Grewal. Higher Engineering Mathematics, Khanna publishers, New Edition.
3. A.S.Negi & S.C.Anand. A Text Book of Physical chemistry, New Edition.
4. Operation Research by Phillips & Ravindran
2. Operation Research by TAHA

Department Of Bio-Tech Engineering
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I Year I Semester
MBT102- CELL AND MOLECULAR BIOLOGY

Module-I

Cell cycle and Genome Organization: Genome Organization in prokaryotes and eukaryotes - DNA content and C-value paradox -methods to measure DNA content variation - Various types of DNA sequences – simple sequences, repetitive sequences, Junk DNA or selfish DNA, tandem gene clusters, satellites Variety of DNA structures: double helix, Z-DNA, B-DNA, Mechanism of DNA replication: prokaryotes and eukaryotes, Overview of the cell cycle, Factors involved in cell cycle, Mitosis, Meiosis, cell cycle control, cell check points.

Module –II

Replication and Cell Signaling Mechanisms: DNA replication models, mode of action, DNA damage, DNA repair and recombination, Organization structures and function of ribonucleoproteins; Photoreactivation; Nucleotide excision repair; Mismatch correction; SOS repair; Recombination: Homologous and nonhomologous; Site specific recombination; Chi sequences in prokaryotes; Gene targeting; Gene

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Module – III

Prokaryotic & Eukaryotic Transcription: Prokaryotic Transcription; Regulation of transcription, Termination-Rho-dependent and independent, Attenuation; Transcriptional regulation-Positive and negative; Operon concept-lac, trp, ara, his, and gal operons; Transcriptional control in lambda phage; Anti-termination, Transcript processing; Processing of tRNA and rRNA Eukaryotic transcription and regulation; RNA polymerase structure and assembly; RNA polymerase I, II, III; Eukaryotic promoters and enhancers; General Transcription factors; TATA binding proteins (TBP) and TBP associated factors (TAF); Activators and repressors; Transcriptional and posttranscriptional gene silencing

Module – IV

Post Transcriptional Modifications: Processing of hnRNA, tRNA, rRNA; 5'-Cap formation; 3'-end processing and polyadenylation; Splicing; RNA editing; Nuclear export of mRNA; mRNA stability; Catalytic RNA.

Translation & Transport: Translation machinery; Ribosomes; Composition and assembly; Universal genetic code; Degeneracy of codons; Termination codons; Isoaccepting tRNA; Wobble hypothesis; Mechanism of initiation, elongation and termination; Co- and post-translational modifications;

Module – V

Diverse type of oncogenes is: Viral and cellular oncogenes; Tumor suppressor genes from humans; Structure, function and mechanism of action of pRB and p53 tumor suppressor proteins; Activation of oncogenes and dominant negative effect; Suppression of tumor suppressor genes; DNA virus/ cell immortalization ,Oncogenes as transcriptional activators. Strategies of chemotherapy and gene therapy against cancer; translating therapies from laboratory to clinic; Gene discovery in cancer research, Mechanisms of diverse type of cancers.

Lab on Cell & Molecular Biology

1. Isolation and Quantitation of cellular macromolecules (DNA, RNA and Protein).
2. cDNA Synthesis
3. Transformation and Preparation of competent cells.
4. Antibiotics sensitivity test on microbial cultures
5. Agarose gel electrophoresis of DNA fragments.
6. SDS PAGE for resolution of proteins.
7. Elution of DNA from an agarose gel.
8. Preparation of metaphase Chromosome.
9. Karyotyping and banding Pattern (G-banding).
10. Preparations of blood smear for study of sex chromatin.

TEXT/REFERENCES:

1. Albert et al., Molecular Biology of the Cell, Garland, New Edition.
2. Rober A. Meyers. Encyclopedia of Molecular Cell Biology and Molecular Medicine, Wiley-VCH Verlag GmbH & Co. KGaA. New Edition.
3. J.M. Walker, R. Rapley. Molecular Biology and Biotechnology, Royal Society of Chemistry, New Edition.
4. G. Karp. Cell and Molecular Biology, John Wiley & Sons. New Edition.
5. Gabi Nindl Waite, Lee R. Waite. Applied Cell and Molecular Biology for Engineers, McGraw Hill. New Edition.
6. Thomas Pollard, Saunders. Cell Biology, New Edition.

I Year I Semester
MBT103 -BIOPROCESS ENGINEERING

Module I

Fundamentals of Bioprocess engineering: Microbial growth, Factors affecting growth, Growth kinetics and metabolism, Stoichiometry: Material and energy balance calculations, Transport phenomenon (mass and energy transfer).

Module II

Bioreactors : Introduction to bioreactors: General design information; Selection of bioprocess equipment (upstream and downstream); Specifications of bioprocess equipment; Batch and Fed-batch bioreactors, Continuous bioreactors; Bioreactor operation; Sterilization; Aeration; Sensors; Instrumentation; Culture-specific design aspects: plant/ mammalian cell culture reactors.

Module III

Upstream processing : Effect of scale on oxygenation, mixing, sterilization, pH, temperature, inoculums development, Media Formulation, nutrient availability and supply; Strain improvement; Bioreactor scale-up based on constant power consumption per volume; mixing time; impellertip speed (shear), mass transfer coefficients; Process economy.

Module IV

Bioseparations / Downstream Processing : Biomass removal and disruption: Filtration; centrifugation; distillation; adsorption; Extraction (solvent, aqueous two phase, super critical), Chromatographic Techniques(Ion exchange, gelfiltration, affinity, HPLC, TLC, GC); Cell disruption (Physical, chemical, enzymatic);
Crystallization; Drying.

Module V

Description of industrial processes : Microbial processes for production of organic acids (citric acid, acetic acid), amino acids (Lysine, isoleucine, glutamic acid, Arginine), antibiotics (Penicillin, Cephalosporin C, actinomycin), alcohol, enzymes. Recombinant protein production in microbes e.g. recombinant insulin; Waste treatment, Process economics.

Lab on Bioprocess Engineering

1. Microbial growth and product formation kinetics.
2. Conventional filtration.
3. Effects of inhibitor on microbial growth.
4. Enzyme immobilization techniques.
5. Bioconversion using immobilized enzyme preparation.
6. Bioconversion in batch.
7. Mixing and agitation in fermenters.
8. Protein precipitation and its recovery.
9. Membrane based filtration-ultra filtration in cross flow modules and micro filtration.
10. Enzyme purification and estimation of enzyme kinetics.

Texts/References

1. Shuler M. and Kargi F. Bioprocess Engineering: Basic Concepts, Prentice Hall, Englewood Cliffs, NJ. New Edition.
2. Doran P., Bioprocess engineering principles, Academic Press, New Edition.
3. Ratledge C., Kristiansen B. Basic Biotechnology, Cambridge University Press, New Edition.
4. Harrison R. et al., Bioseparations Science and Engineering, Oxford University Press, New Edition.
5. Harris and Angal S. Protein Purification Methods, Ed. IRL Press at Oxford University Press, New Edition.
6. Belter P.A., Cussler E.L., and Hu Wei-Shou. Bioseparations-Downstream Processing for Biotechnology, Wiley-Interscience Publication, New Edition.
7. Bailey J. E. and Ollis D. F. Biochemical Engineering Fundamentals, Mc-Graw Hill, Inc., New Edition.
8. Scopes R. K., Berlin. Protein Purification: Principles and Practice, Springer, New Edition.
9. Biotol series. Product Recovery in Bioprocess Technology, Butterworth Heinemann Ltd., New Edition.

Department Of Bio-Tech Engineering
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P.K. University, Shivpuri (MP)

I Year I Semester
MBT104 -CELL & TISSUE CULTURE

Module-I:

Culture Technique: Animal: Structure of animal cell; History of animal cell culture; Basic requirements for animal cell culture; Cell culture media and reagents; Animal cell, tissue and organ cultures; Primary culture, secondary culture; Continuous cell lines; Suspension cultures; Somatic cell cloning and hybridization; Transfection and transformation of cells.

Module-II:

Applications of culture techniques: Animal: Commercial scale production of animal cell, Stem cells and their application; Application of animal cell culture for *in vitro* testing of drugs; Testing of toxicity of environmental pollutants in cell culture; Application of cell culture technology in production of human and animal vaccines and pharmaceutical proteins.

Module-III:

Culture Techniques: Plant: Totipotency, Cyto-differentiation; Organogenesis; Somatic embryogenesis; Regulation and applications; Artificial seed production; Micropropagation; Somaclonal variation; Androgenesis and its applications in genetics and plant breeding; Germplasm conservation and cryopreservation, Virus free culture and its applications.

Module-IV:

Plant Tissue Culture: Protoplast Culture and Somatic Hybridization: Protoplast isolation; Culture and usage; Somatic hybridization - methods and applications; Cybrids and somatic cell genetics and its application, cytoplasmic sterility, secondary metabolite production.

Module-V:

Applications of Plant tissue culture: Role of tissue culture in agriculture, horticulture and forestry, Transgenic plants Technique of transformation– Agrobacterium mediated, Applications of transgenic plants. Edible Vaccines from plants – Banana, Watermelon.

Lab on Tissue Culture

1. Aseptically media preparations.
2. Cryopreservation of cells and retrieval of cells.
3. Maintenance and development of cell passage.
4. Handling of secondary animal cell culture.

5. Identification of contaminants in animal cell culture.
6. Subculturing of continuous cell line growing in monolayer and suspension.
7. Construction and analysis of growth curve.
8. Isolation of primary cell culture.
9. Plant Protoplast Isolation.
10. Plant propogation through Tissue culture (shoot tip and Nodal culture).

Texts/References:

1. Adrian Slater, Nigel Scott and Mark Fowler. Plant Biotechnology: The genetic manipulation of plants, Oxford University Press, New Edition.
2. Bhjowani and Razdan. Plant Tissue Culture, Elsevier publication, New Edition.
3. Freshney I. Culture of Animal cells, Wiley-liss, New Edition.
4. Bruce Alberts. The Cell, New Edition.
5. H.S.Chawla. An Introduction to Plant Biotechnology. Oxford & IBH Publishing Co. Pvt. Ltd. New Edition.
6. J. P. Mather, P. E. Roberts. Introduction to Cell and Tissue Culture. Plenum Press. New Edition.

Department Of Bio-Tech Engineering
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I Year I Semester
MBT105 -GENOMICS AND GENETIC ENGINEERING

Module-I

Genetic engineering tools: Restriction Enzymes; The range of DNA manipulative enzymes (Nucleases, Ligases, Polymerases, Modifying enzymes, Topoisomerases); Cohesive and blunt end ligation (Linkers, Adaptors, Homopolymer tailing); Labeling of DNA (Radioactive and Non-radioactive); Plasmids; Bacteriophages; M13 mp vectors; pUC19 and Bluescript vectors, Phagemids; Lambda vectors; Cosmids; Artificial chromosome vectors (YACs; BACs); Animal Virus derived vectors

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Module- II

Genomic Analysis: Insertion of Foreign DNA into Host Cells; Construction of libraries; Isolation of mRNA and total RNA; cDNA synthesis and cloning; genomic libraries; Expression cloning; jumping or hopping libraries; Southwestern and Farwestern cloning; Protein-protein interactive cloning and Yeast two hybrid system; Phage display;. Hybridization Techniques (Colony Hybridization, Fluorescence in situ Hybridization); DNA-Protein Interactions .

Module- III

PCR and Its Applications: Primer design; Fidelity of thermostable enzymes; Types of PCR (multiplex PCR, nested PCR, reverse transcriptase PCR, real time PCR, touchdown PCR, hot start PCR, colony PCR); cloning of PCR products; vectors for cloning; 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, Mutation

Module-IV

Post Genomic analysis: Enzymatic DNA sequencing; Chemical sequencing of DNA; Automated DNA sequencing; RNA sequencing; Chemical Synthesis of oligonucleotides; Gene silencing techniques; siRNA & stRNA technology; Micro RNA; Construction of siRNA vectors; Principle and application of gene silencing; Gene knockouts; Creation of knock out mice; Identification and classification using molecular markers- ribosomal typing/sequencing.

Module- V

Genetic engineering applications: Gene therapy in Disease models (Cancer, Diabetes, AIDS, Thalassaemia); Somatic and germline therapy- *in vivo* and *ex-vivo*; Suicide gene therapy; Gene replacement; Gene targeting; Transgenics; cDNA and intragenic arrays; Differential gene expression and protein array.

Lab on Genetic Engineering

1. Plasmid DNA isolation and DNA quantitation.
2. PCR amplification of genes and analysis by agarose gel electrophoresis.
3. Cloning using pUC18 and pBR 322.
4. Transformation of recombinant plasmid in to host.
5. Non-radioactive Random Primer labeling.
6. Blotting techniques: (Southern, Western, Northern)
7. Southern hybridization with genomic DNA with non-radioactive labeled probe detection.
8. RFLP analysis of the PCR product.
9. Introduction of DNA into mammalian c ells; Transfection techniques;
10. Preparation of genomic DNA library in plasmid vector.

Text/References:

1. S.B. Primrose, R.M. Twyman and R.W.Old. Principles of Gene Manipulation. S.B.University Press, New Edition.
2. J. Sambrook and D.W. Russel. Molecular Cloning: A Laboratory Manual, CSHL, New Edition.

Department Of Bio-Tech Engineering
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P.K. University, Shivpuri (MP)

I Year II Semester
MBT 201- IPR & BIOSAFETY

Module-I

Introduction to Intellectual Property: Types of IP: Patents, Trademarks, Copyright & Related Rights, Industrial Design, Traditional Knowledge, Geographical Indications, Protection of GMOs IP as a factor in R&D; IPs of relevance to Biotechnology

Module-II

Agreements and Treaties: History of GATT & TRIPS Agreement; Madrid Agreement; Hague Agreement; WIPO Treaties; Budapest Treaty; PCT; Indian Patent Act 2005 & recent amendments.

Module-III

Basics of Patents and Concept of Prior Art: Introduction to Patents; Types of patent applications: Ordinary, PCT, Conventional, Divisional and Patent of Addition; Specifications: Provisional and complete; Forms and fees Invention in context of "prior art"; Patent databases; Searching International Databases; Country-wise patent searches (USPTO,esp@cenet (EPO), PATENT Scope (WIPO), IPO, etc.)

Module-IV

Patent filing procedures: National & PCT filing procedure; Time frame and cost; Status of the patent applications filed; Precautions while patenting – disclosure/non-disclosure; Financial assistance for patenting - introduction to existing schemes. Patent licensing and agreement Patent infringement- meaning, scope, litigation, Deliberate testing-Transgenic testing, Centers in India for Testing.

Module-V

Biosafety: Introduction; Principles of laboratory biosafety and biosecurity; Risk assessment: Occupational health hazards and laboratory associated infections (LAIs); Laboratory biosafety level criteria and biosafety laboratory design; Primary containment for biohazards: Selection, installation and used of biosafety cabinets; Decontamination and disinfection; Safe working practices in biorisk areas and waste management of biohazards; Biosafety guidelines - Government of India; Definition of GMOs & LMOs; Institutional Biosafety Committee (IBSC), Institutional Animal Ethics Committee (IAEC), Review Committee for Genetically Modified organisms (RCGM),Genetic Engineering Approval Committee (GEAC) etc. for GMO applications in food andagriculture; Environmental release of GMOs. Handling and transportation of infectious material and genetically modified products.

TEXTS/REFERENCES:

1. BAREACT, Indian Patent Act 2005, Acts & Rules, Universal Law Publishing Co. Pvt. Ltd., 2007.

2. Kankanala C. Genetic Patent Law & Strategy, 1st Edition, Manupatra Information Solution Pvt. Ltd., 2007.

3. M. K. Sateesh I. K. International Pvt. Ltd. Bioethics and Biosafety, 2008.

4. Frederic H. Erbisch, Karim M. Maredia. Intellectual property rights in agricultural biotechnology, CAB International publication, USA, New Edition.

5. Rajmohan Joshi. Biosafety and Bioethics, Gyan Publishing House, 2006.

Department Of Bio-Tech Engineering
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I Year II Semester
MBT202-BIO-ENTREPRENEURSHIP

Module I

Accounting and Finance: Taking decision on starting a venture; Assessment of feasibility of a given venture/new venture; Approach a bank for a loan; Sources of financial assistance; Making a business proposal/Plan for seeking loans from financial institution and Banks; Funds from bank for capital expenditure and for working; Statutory and legal requirements for starting a company/venture; Budget planning and cash flow management; Basics in accounting practices: concepts of balance sheet, P&L account, and double entry bookkeeping; Estimation of income, expenditure, profit, income tax etc.

Module II

Marketing: Assessment of market demand for potential product (s) of interest; Market conditions, segments; Prediction of market changes; Identifying needs of customers including gaps in the market, packaging the product; Market linkages, branding issues; Developing distribution channels; Pricing/Policies/Competition; Promotion/Advertising; Services Marketing

Module III

Negotiations/Strategy: With financiers, bankers etc.; with government/law enforcement authorities; with companies/Institutions for technology transfer; Dispute resolution skills; External environment/changes; Crisis/ Avoiding/Managing; Broader vision–Global thinking

Module IV

Information Technology: How to use IT for business administration; Use of IT in improving business performance; Available software for better financial management; E-business setup, management.

Human Resource Development (HRD): Leadership skills; Managerial skills; Organization structure, pros & cons of different structures; Team building, teamwork; Appraisal; Rewards in small scale set up.

Fundamentals of Entrepreneurship Support mechanism for entrepreneurship in India

Module V

Role of knowledge centre and R&D: Knowledge centres like universities and research institutions; Role of technology and up gradation; Assessment of scale of development of Technology; Managing Technology Transfer; Regulations for transfer of foreign technologies; Technology transfer agencies.

TEXTS/REFERENCES:

1. Shkula. S. M. Advanced Accountancy, Masherwari, Sahitya Bhawan, Agra.
2. Kotler. P. Marketing Management, Prentice Hall of India Limited.
3. Staton. E.J. Fundamentals of Marketing Tata McGraw Hill.
4. Mote. V. L. Paul. S and Gupta. G. S. Managerial Economics Concepts and Cases, Tata McGrw Hill Limited.

Department Of Bio-Tech Engineering
(Faculty of Engineering & Technology)
P.K. University, Shivpuri (MP)

I Year II Semester
MBT 203- IMMUNO-TECHNOLOGY

Module I

Introduction: Immunology- fundamental concepts and anatomy of the immune system, Immune memory, Immune tolerance; Phagocytosis; Complement and Inflammatory responses; Haematopoesis; Mucosal Immunity; Antigens - immunogens, haptens; Major Histocompatibility Complex - MHC genes, MHC and immune responsiveness and disease susceptibility, HLA typing.

Module II

Hybridoma Technology: Hybridoma techniques and monoclonal Ab production- myeloma cell lines, fusion of myeloma cell lines with Ab producing B cells , fusion methods, selection and screening methods, for positive hybrids, -cloning methods- production and purification and characterization of MAb. Application of MAb in biomedical research, in clinical diagnosis and treatment. Production of human MAb and their applications. Production of polyclonal Ab with different type of Ag: Ag preparation and modification, adjuvants, dose and route of Ag administration,collection of sera.

Module III

Immunotechniques-Antigen-Antibody interactions: Immunoprecipitation- mancini method, ouchterloney method, immune electrophoresis, rocket immunoelectrophoresis, crossed immunoelectrophoresis, agglutination and complement mediated immune reactions; Advanced immunological techniques - RIA, ELISA, Western blotting, ELISPOT and ELAST assay, peptide based immuno binding assay, peptide mapping, epitope mapping, flurosence and photo illuminance based immunoassay, DELPHIA and SLFIA, concept of immunohisto / cyto-chemistry, immunofluorescence, flow cytometry and immunoelectron microscopy; detection of molecules in living cells, *in situ* localization by techniques such as FISH and GISH. Surface plasmon resonance, Biosenor assays for assessing ligand–receptor interaction, CMI techniques- lymphoproliferation assay, Mixed lymphocyte reaction, Cell Cytotoxicity assays, Apoptosis, Microarrays, Transgenic mice, Gene knock outs.

Module IV

New generation Vaccines: Immunobiotechnology: Vaccines and Vaccination, types of vaccines including new generation vaccines. Tumorimmunology. Active and passive immunization; Live, killed, attenuated, sub unit vaccines; Vaccine technology- Role and properties of adjuvants, recombinant DNA and protein based vaccines, plant-based vaccines, reverse vaccinology; Peptide vaccines, conjugate vaccines; Antibody genes and antibody engineering- chimeric and hybrid monoclonal antibodies; Catalytic antibodies and generation of immunoglobulin gene libraries.

Module V

Clinical Immunology: T-cell cloning-importance of Ag presentation and MHC class II molecules in T-cell cloning, Ag specific and alloreactive T-cell cloning, use of T-cell cloning – cell cloning in understanding the immunologically relevant Ag and T-cell epitopes, application of T cell cloning in vaccine development. Hypersensitivity – Type I-V; Autoimmunity; Types of autoimmune diseases; Mechanism and role of CD4+ T cells; MHC and TCR in autoimmunity; Treatment of autoimmune diseases; Transplantation – Immunological basis of graft rejection; Clinical transplantation and immunosuppressive therapy; Tumor immunology – Tumor antigens; Immune response to tumors and tumor evasion of the immune system,Cancerimmunotherapy;Immunodeficiency-Primary immunodeficiencies, Acquired or secondary immunodeficiencies.

LAB Of IMMUNOLOGY:

1. Single Radial Immuno Diffusion.
2. Double diffusion.
3. Rocket Immunoelectrophoresis.
4. Counter- Current Immunoelectrophoresis.
5. Characterization of Immunoglobulins by SDS-PAGE.
6. Antibody titre by ELISA method.
7. Isolation of Lymphocytes from human blood and Culture
8. Culturing and maintenance of cell lines
9. Immunoblotting, Dot blot assays.
10. Abs Production.

TEXTS/REFERENCES:

1. Kuby, RA Goldsby, Thomas J. Kindt, Barbara, A. Osborne. Immunology, New Edition.
2. Brostoff J, Seaddin JK, Male D, Roitt IM. Clinical Immunology, Gower Medical Publishing, New Edition.
3. Janeway et al., Immunobiology, Current Biology publications. New Edition.
4. Paul. Fundamental of Immunology, Lippencott Raven, New Edition.
5. Goding. Monoclonal antibodies, Academic Press. New Edition.
6. P. Delves, S. Martin, D. Burton and I. Roitt. Essential Immunology, Eleventh Edition (2006) Wiley-Blackwell Publishers, UK.

Department Of Bio-Tech Engineering
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I Year II Semester
MBT 204 -STEM CELL TECHNOLOGY

Module-I

Introduction to Stem Cells

Stem Cells: Definition, Classification and Sources, Blastocyst Culture, Xeno-free Derivation and Cryopreservation, Properties and Applications of Embryonic Stem Cells, Characterization of Human Embryonic Stem Cells, Stem Cells and their Developmental Potential. Culture, Subcloning, Spontaneous and Controlled Differentiation of Human Embryonic Stem Cells, *In Vivo* and *In Vitro* Differentiation of Human Embryonic Stem Cells, Feeder-free Culture of Human Embryonic Stem Cells,

Module-II

Standardization and Quality Assurance

Generation and Expansion of pluripotent Stem cells, Epigenesis in Pluripotent Cells, Organogenesis, Mammalian Nuclear Transfer Technology, Novel Strategies for the mobilization of HSC, GMP : clinical scale production of MSCs,

Module-III

Regenerative Medicine

Stem Cell therapy for Neurodegenerative Diseases: Parkinson's, Alzheimer, Spinal Cord injuries and other brain syndromes, Tissue system failures, Diabetic Cardiomyopathy, kidney failure, liver failure, Leukaemia, transplantation.

Module-IV

Cancer stem cells

Purification and characterization of cancer stem cells, therapeutic implications of cancer stem cells: Preventative and therapeutic strategies for cancer stem cells, Targeting acute myelogenous leukaemia stem cells, targeting cancer stem cell pathways: Hedgehog/GLI signalling, Notch signalling pathway, Wnt.

Module-V

Human Embryonic Stem Cells and society

Human Stem cells research: ethical considerations, stem cell religion consideration, Stem Cell based therapies: pre-clinical regulatory consideration and patient advocacy, Intellectual property issues surrounding Human Embryonic Stem cells study.

LABORATORY EXERCISE

1. Preparation of feeder cell culture.
2. Culturing of Stem cell line.
3. Isolation of cells from blastocyst.
4. Growing mesenchymal stem cell.
5. Preservation of cord blood.
6. Stem cell isolation from umbilical cord.
7. Types of cleavage, invertebrates, vertebrates,and permanent preparations – stains of stages of blastula
8. Development of Amphibian – Gestulation – Metamorphosis
9. Sex determination – Drosophila (Prescribed assignments with problems in genetic)
10. Stem cells –Identification of cells by staining of bone marrow – (Animal example)

TEXTS/REFERENCES BOOKS:

1. S.F.Gillert, Sinauer. Developmental Biology, Associates inc., Massachuselts. New Edition.
2. Ethan Bier. The coild spring Cold Spring Harbor Lab Press, New York. New Edition.
3. Freshney, R. I. Culture of Animal Cells. Wiley-Liss. New Edition.
4. Masters, J. R. W. Animal Cell Culture – Practical Approach, Oxford Univ. Press. New Edition.
5. Basega, R. Cell Growth and Division: A Practical Approach. IRL Press. New Edition.
6. Butler, M and Dawson, M. Cell Culture Lab Fax, Eds., Bios Scientific Publications Ltd., Oxford. New Edition.
7. Clynes, M. Animal Cell Culture Techniques. Springer. New Edition.

Department Of Bio-Tech Engineering
(Faculty of Engineering & Technology)
P.K. University, Shivpuri (MP)

I Year II Semester
MBT 205 - PROTEOMICS & PROTEIN ENGINEERING

Module I

Architecture of Proteins: Amino acids, classification of proteins, Protein Structure: primary, secondary, tertiary and quaternary. Protein folding, thermodynamics and kinetics of protein folding, Protein Stability: protein stability & associated factors. Detection, identification and quantification of amino acids and proteins, *In-silico* protein modeling.

Module II

Control of Protein Function: Mechanisms of Regulation, Protein Interaction Domains, Regulation by Location, Effector Ligands: Competitive Binding and Cooperativity, Conformational Change and Allostery, Protein Switches Based on Nucleotide Hydrolysis, GTPase Switches: Small Signaling G Proteins, Signal Relay by Heterotrimeric GTPases, Protein Synthesis, Motor Protein Switches, Regulation by Degradation, Control of Protein Function by Phosphorylation, Regulation of Signaling Protein Kinases: Activation Mechanism, Cdk Activation, Two-Component Signaling Systems in Bacteria, Control by Proteolysis, Protein trafficking.

Module III

Protein – Protein Interactions: Charting protein–protein interactions: Topoisomerase-based cloning, Univector plasmid-fusion system, Two-hybrid analysis protein-protein interactions in yeast, viral, bacteria systems. Use of phage display to detect protein-ligand interactions, Detecting interactions by protein fragment complementation assays.

Module IV

Protein Engineering & Protein Design: Outline of bioengineering of macromolecules a multidisciplinary approach; Methods to alter primary structure of protein: site directed mutagenesis; examples of engineered proteins, protein design, principles and examples. Steps involved in protein engineering and protein modeling to the desired needs.

Module V

Techniques: Protein engineering: Physical methods of determining the three-dimensional structure of proteins (X-ray crystallography, Nuclear magnetic resonance spectroscopy, Cryoelectron microscopy, Neutron diffraction, Optical spectroscopic techniques, Vibrational spectroscopy, Raman spectroscopy), Use of 2-D PAGE, sensitivity and resolution and representation of 2-D gels, multiplexed analysis to show expression profiles; circular dichroism (CD), MALDITOF and MALDITOFTOF, special strategies for qualitative and quantitative

analysis. Protein array for expressional analysis, profiling and functional analysis, application of proteomics to medicine.

LAB OF PROTEIN ENGINEERING

1. Using absorbance coefficients and extinction coefficients to estimate protein concentration
2. Protein quantitation when contaminating nucleic acids are present
3. Measuring protein concentration by colorimetric assay - the Bradford assay
4. The nitric acid method for protein estimation in biological samples
5. Quantitation of Tryptophan in Proteins
6. The CAT (chloramphenicol acetyltransferase) Assay
7. Use of Luciferase in a reporter assay
8. *In vitro* translation - Determining amino acid incorporation
9. Casting Immobilized pH Gradients (IPGs)
10. Carboxymethylation of cysteine using iodoacetamide/iodoacetic acid
11. Analyzing Protein Phosphorylation

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