ST. JOSEPH'S COLLEGE, BANGALORE
DEPARTMENT OF BIOTECHNOLOGY
V SEMESTER PAPER V-BT 5 112

Cellular Immunology and Gene Expression and Regulation (45 hrs)

This course builds on the Essential Immunology and Molecular Biology course of the IV semester. The students are presented with a more in depth treatment of concepts in immunology and gene expression and regulation.

Scope: This course is designed for undergraduate students of Biotechnology. It educates the students in finer details of immune responses. It also provides the student a clearer understanding of the central dogma of molecular biology and methods of gene regulation. The practical sessions train the student in selected basic techniques in genetic engineering.

Cellular Immunology **20 hrs**

UNIT 1-Immunoreactive Cells **4 hrs**

T cells – Markers, Functions of T cell subsets – T_H, CTLs – mode of action, T_R. 2 hrs

B cells – Markers, ontogeny, heterogeneity; Activation, B cell differentiation – Memory B cells, Plasma cells 2 hrs

UNIT 2-Antigen Processing and Presentation **2 hrs**

Types of Antigen Presenting cells, Antigen Processing Pathways- Endocytic and Endogenous Processing Pathways, Functions of APCs.

UNIT 3- Cell Mediated Immunity **2 hrs**

Mechanism of cell mediated toxicity 1 hr

Perforin and Granzyme pathway, Death receptor ligand pathway, ADCC 1 hr

UNIT 4-Immunotolerance **2 hrs**

Central Tolerance, Peripheral tolerance, Tolerance induction

UNIT 5-Transplantation Immunology **3 hrs**

Antigens involved in graft rejection, Allorecognition – Direct and indirect. 1 hr

Graft rejection - Role of APCs, Effector cells, Graft Vs Host Disease (GVHD) 1 hr

Immunosuppressive therapies – Induction Therapy and Maintenance therapy 1 hr

UNIT 6- Hypersensitivity **3 hrs**

Characteristics and types 1 hr

Type I – Cells involved, Factors, Diagnosis, Treatment 1 hr

Type II - Types, reasons, Type III , Type IV 1 hr

UNIT 7-Autoimmune Diseases **1 hr**

Introduction, Factors – Natural, genetic predisposition, Environmental factors, with an example

UNIT 8-Vaccines **3hrs**

Introduction to vaccines 0.5hr

Types of vaccines- live viral vaccines (Polio), attenuated viral vaccines (influenza), subunit vaccines (Hepatitis B), killed bacterial vaccines (typhoid), attenuated bacterial toxin (tetanus) 2hrs

Difficulties in making vaccines against diseases 0.5hr

Gene Expression and Regulation **25 hrs**

UNIT 1-Concept of Regulation **1 hr**

Steps involved, Role of factors in the regulation of biotic & abiotic stress and hormones.

UNIT 2- Transcription **7 hrs**

Central Dogma of Molecular Genetics 0.5hr

Introduction to transcription, General Transcription Process- Prokaryotic - Concept of upstream ,downstream, sense & antisense.

Promotor sequences. Meaning of conservative and concensus. 0.5hr

Mechanism of transcription in prokaryotes and eukaryotes – Initiation, Elongation and its factors and termination. 2 hrs

Polymerase and Rho factor protein structure. 1 hr

Eukaryotic transcription- transcription factors, polymerases.

Upstream Activation sites and Enhancers. Initiation, elongation and termination 1 hr

DNA binding proteins – types - helix loop helix, helix turn helix, leucine zippers and Zinc fingers; DNA foot printing. 1 hr

UNIT 3-Post Transcriptional Modifications **2 hrs**

Capping, Tailing, Splicing (Mechanisms, Role of snRNPs)

UNIT 4- Prokaryotic Gene Regulation **5 hrs**

Concept of Regulation, Operon model, Contribution of Jacob and Monod 1 hr

Lac operons; Negative control and Positive control. 3 hrs

Trp operon-Repression and Attenuation 1 hr

UNIT 5-Translation **8 hrs**

Genetic code in detail 1 hr

Prokaryotic and eukaryotic ribosome structure 1 hr

Secondary and tertiary structure of tRNA, activation of t-RNA 1 hr

Mechanisms of translation in prokaryotes – Initiation, elongation and termination 2 hrs

Mechanism in eukaryotes 2 hrs

UNIT 6-Post Translational Modification of Protein **2 hrs**

Role of chaperones – ER – Golgi and packaging of proteins 1 hr

Hydroxylation and other modifications of proteins (for membrane, organelle and nuclear proteins) 1 hr

References:

Immunology:

Immunology by Richard A. Goldsby,Thomas J.Kindt, Barbara A. Osborne & Janis Kuby Immunology by Ivan M. Roitt, Jonathan Brostoff & David K. Male

Immunology: Essential and Fundamental by Sulabha Pathak & Urmi Palan.

Immunology a comprehensive review:Darla J. Wise & Gordon R. Carter-Anebooks

Lecture notes in Immunology: Ian Todd & Gavin Spicket-Blackwell Publishing

Blue print notes & Cases: Microbiology and Immunology: Monica Gandhi et.al., Blackwell publishing.

Schaum's Immunology : George R.Pinchuk

Essential Immunology: Viva books private Ltd.

Gene Expression and Regulation:

Molecular Biology by Freifelder, D.

Genetics by Gardner

Fundamentals of Genetics by Singh, B.D.

The Cell by Cooper

PRACTICAL V (BTP 5-112)
Techniques in Genetic Engineering I

Session I	**:**Extraction and estimation of protein from plant material.
Session II	**:**SDS-PAGE of Extracted protein
Session III	**:**DNA extraction from cauliflower or spinach.
Session IV	**:**DNA extraction from liver tissues.
Session V	**:**Genomic DNA extraction from bacterial cells.
Session VI	**:**Electrophoresis of extracted Genomic DNA
Session VII	**:**Extraction of RNA from yeast cells.
Session VIII	**:**DNA extraction –any material can be given.
Session IX	**:**Chromatography-ion exchange-purification of lysozyme from egg

ST. JOSEPH'S COLLEGE, BANGALORE
DEPARTMENT OF BIOTECHNOLOGY
V SEMESTER PAPER VI-BT 5 212
Genetic Engineering and Biophysics, Bioinformatics and Entrepreneurship (25+20 hrs)

This course deals with more advanced concepts of Genetic engineering and also introduces the disciplines of Biophysics and Bioinformatics, besides briefly discussing entrepreneurship in Biotechnology.

Scope: This course is tailored for undergraduate students of Biotechnology. It gives the student a clearer understanding of the principles and techniques involved in Genetic Engineering. The course also introduces the student to Bioinformatics, Biophysics and scientific entrepreneurship. The practical sessions provide hands on training and demonstration of selected techniques in Genetic Engineering, besides introducing bioinformatics techniques and programs

Genetic Engineering **25 hrs**

UNIT 1-Introduction **1 hr**

Principles of Recombinant DNA Technology & Genetic Engineering –Techniques (in brief), its applications, goal and ethical issues; Concept of Vectors and Restriction Endonucleases

UNIT 2-General Methods of Transformation **4 hrs**

Competence-Induction and significances, Microinjection, Lipofection, Electroporation Macroinjection, Sonication, Silicon carbide fibre vortex, DNA coprecipitation, Ultrasonication, Laser Induced, Use of *Agrobacterium* (Methodology, Advantages and Disadvantages)

UNIT 3-Vectors **20 hrs**

Natural and artificial plasmids, sources 1 hr
Restriction Endonucleases 1 hr
DNA ligase, Linkers and Adapters, Alkaline Phosphatase, Polynucletide kinase, Terminal transferases, S1 nuclease 1 hr
Polymerases-Klenow fragment, Pol I, *Taq* polymerase, Reverse transcriptase
Roles of RNAse (Definition, types, features, mode of action, application) 3 hrs
List of plasmids and their unique restriction sites 1 hr
Cloning Vectors based on bacterial plasmids, Scheme of cloning-restriction, ligation transformation, selection of clones-Application and Significance 3 hrs
Lambda Bacteriophages-Insertional vectors and Replacement vectors Features, Design. 2 hrs
M13 Bacteriophage-Features, Design, Advantages 1 hr
Cosmids, Phagemids and Phasmids- Definition, features, design with examples. 2 hrs
Genomic libraries and cDNA libraries, PCR with primer designing and gene sequencing 3 hrs
List of vectors for cloning in *Saccharomyces cerevesiae*-Feature, Examples 1 hr
YAC-Features, uses 1 hr

Biophysics, Bioinformatics and Entrepreneurship **20 hrs**

UNIT 1-Introduction **1 hr**

Scope and development of Biophysics

UNIT 2-Analytical techniques **4 hrs**

Principles and applications of

a) Chromatography (Paper, thin-layer, column)

b) Centrifugation (rpm and g, Ultracentrifugation)

UNIT 3-Spectroscopic Techniques **3 hrs**

UV, visible spectroscopy, X-ray crystallography

UNIT 4-Isotopes **2 hrs**

Types, their importance in biological studies, measure of radioactivity, GM counters & Scintillation counting

UNIT 5-Bioinformatics **8 hrs**

Concept and structure of databases

Introduction to the human genome project and components of the genome Introduction to the gateway sites (NCBI, EMBL and DDBJ).

Types of nucleic acid sequences–Genebank

Protein Data Bank (PDB)–in the context of protein structural biology

Data retrieval: Example of research literature and demonstrations in PubMed

Introduction to sequence analysis, significance, motif analysis and phylogenic comparisons

Concept and methods of sequence comparisons in general: BLAST and CLUSTALW, pair wise sequence comparison, Scoring matrices, Gap Penalties, Global Alignment, Local Alignment,

UNIT 6-Entrepreneurship **2 hrs**

Introduction, Opportunity scouting, idea generation, business plan

Reference:

Genetic Engineering

Watson, J.D., Tooze, J. and Kurtz, D.T., Recombinant DNA: A short Course, Scientific American Books, New York.

T.A.Brown, Essential Molecular Biology a Practical Approach Vol I & II -Oxford University Press

T. A. Brown, Genomes

Bruce Alberts, Molecular Cell Biology

Ernst L. Winnacker, From Genes to Clones: Introduction to Gene technology- Panima Publishing Corporation.

Principles of Gene Manipulation and Introduction to Genetic Engineering, 3rd Ed,

Purohit,S.S., Biotechnology Fundamentals and Application- Himalaya Publications.

Drlica, K. 1984, understanding DNA and Gene Cloning: A Guide for the Curious, John Wiely & Sons, New York.

Glick & Pasternack, Molecular Biotechnology.

Biophysics:

P. Narayanan, Essentials of Biophysics

Upadhyay, Upadhyay and Nath, Biophysical Chemistry: Principles and Techniques

Bioinformatics:

Introduction to bioinformatics by Sundararajan and
Balaji Bioinformatics by Murthy

Developing Bioinformatics computer skills by Cynthia Gibas and Per Jambeck O'reilly April 2001: first edition.

Bioinformatics-concepts, skills, and applications, By S.C Rastogi, Namita Mendiratta and Parag Rastogi. CBS publisher 2003: First edition

Introduction to Bioinformatics by Arthur M. Lesk. Oxford University Press 2002: 1st edition.

Bioinformatics-sequence and genome analysis by David W. Mount. Cold Spring Harbour laboratory Press.2001

Practical VI: (BTP 5-212)

Techniques in Genetic Engineering II and Bioinformatics

Session I	**:** Isolation of plasmid from an assigned organism
Session II	**:** Single and Double Restriction digestion of the plasmid DNA (Eco, R1, Hind III, BamHI) and its analysis by Electrophoresis.
Session III	**:** Purification of an isolated fragment.
Session IV	**:** Ligation of a fragment to a restricted vector.
Session V	**:** Preparation of competent cells
Session VI	**:** Transformation of ligated DNA
Session VII	**:** Screening of Transformants.
Session VIII	**:** Bioinformatics-PubMed, Mapviewer
Session IX	**:** Pairwise alignment-Blast and CLUSTAL-W
Session X	**:** Structure analysis tool

PATTERN OF QUESTION PAPER FOR FINAL YEARS – SEMESTER END EXAM PAPER
ST. JOSEPH'S COLLEGE (AUTONOMOUS), BANGALORE
B.Sc EXAMINATION, BIOTECHNOLOGY DEPARTMENT

TIME -3HRS MAX MARKS-100

I. Explain/Define any FIFTEEN of the following 3x15=45
Number of questions to be asked-18only

II. Write short notes on any FIVE of the following 5x5=25
Number of question to be asked-7only

III. Answer in detail any THREE of the following 10x3=30
Number of questions to be asked -5 only