Ordinances for "Course Work" for Ph.D. programme
(Updated as per notification RAC/RES/UACB/-21-4-22/ dated 23.04.2022)
SCHOOL OF BIOTECHNOLOGY
Institute of Science

Course work:

Every student admitted in a discipline for Ph.D. programme in the Faculty of Science will be required to pass a 'course work' of minimum 16 credits.

The candidate can submit his/her thesis only after passing the course work.

The 16 credit course will normally be spread over two semesters.

Division of the 16 credits will be as follows:

I Semester

(i) Faculty level Compulsory Courses:
Ethics of Science
Science Communication
Research Methods & Good Lab practices

(ii) Subject – Specific Courses (3 credits each) -**12 credits**
Students will opt any 4 out of the proposed elective courses as per RPC recommendation.

II Semester

(iii) Practical work/dissertation, seminar presentation, book review etc. -**4 credits**
The courses for these 4 credits will be include courses related to practical work, dissertation, seminar presentation, book review etc. (to be conducted in the concerned lab of the allotted supervisor)decided by the RPC of the concerned candidate.

Each discipline will announce the courses to be offered in a given semester prior to beginning of the semester and the research scholars will register themselves, in consultation with their RPC, for different courses.

Ph.D. scholars in one discipline may register themselves for courses offered by other disciplines if this is mutually permitted.

Examination Pattern and Evaluation:

Only end-semester examinations will be held for the Ph.D. courses offered in a given semester.

Normally examinations will be held one time in a year as per notification of the Controller of Examinations. Every student will be required to fill up the examination form within the stipulated time notified by the Controller of Examinations. A candidate will be eligible for appearing in the examination, if he/she fulfills the minimum attendance requirement as well as filling of examination form within the stipulated time.

Attendance requirement will be the same as provided in Ph.D. ordinances.

A candidate, who does not fulfill the above requirement, will not be allowed to appear in the concerned examination.

Based on performance of the candidate in the examination and other assessments, the candidate will be declared pass or fail. A candidate will be declared pass in a theory and practical course if he/ she secures at least 50% marks in the course. For other items such as literature review/ preparation of research plan proposal/ field work etc. the candidate will be declared passed or failed based on assessment by the concerned RPC.

The candidate will be considered to have passed the course work of the Ph.D. programme only when he/ she has passed all the items of the course.

There will be no evaluation/examination for the Faculty common courses: all research scholars will attend these courses and secure the minimal attendance requirement to qualify.

Evaluation for preparation and presentation of seminar on research plan proposal and the other seminar (where applicable) will be by the concerned RPC while the course work will be evaluated by examiners appointed by the Board of Examiners as in the case of the discipline-specific courses.

A candidate has to clear the course work in a maximum of the first four available semesters* of the residency period from the date of registration. A candidate can take maximum two attempts for passing a course/ item. If he/ she does not pass even within this period, his/ her Ph.D. registration shall stand cancelled. There will be no provision of suplementatry examination.

**** For those candidates who have been admitted in forthcoming sessions, this period will be applicable from the session 2022-23.***

School of Biotechnology

Course Work for Ph.D. Students

Total 16 credit courses will be taught to the Ph.D. student as follows;
I Semester

I. Research specific elective courses **Credits: 12**

Selection of this course will depend on the specific recommendation of Research Progress Committee (RPC) of each research scholar depending on his/her individual requirements and/or deficiencies. **Any four** of the following elective courses (3 credit each) will be recommended by the RPC to the Ph.D student.

Immunology	BTPR 101	Credits: 3
Animal Cell Culture	BTPR 102	Credits: 3
Genetics and Molecular Biology	BTPR 103	Credits: 3
Genetic Engineering	BTP 104	Credits: 3
Biochemistry and Biophysics	BTPR 105	Credits: 3
Enzymology and Enzyme Technology	BTPR 106	Credits: 3
Cell Biology	BTPR 107	Credits: 3
Plant Biotechnology	BTPR 108	Credits: 3
Microbiology	BTPR 109	Credits: 3

Annexure-I

I. Research theme specific elective courses Credits: 12

I.1. Immunology BTPR 101 Credits: 3

1. Introduction: Innate and acquired immunity, clonal nature of immune response.
2. Nature of antigens.
3. Antibody structure and function.
4. Antigen - antibody reactions and applications.
5. Major histocompatibility complex.
6. Complement system.
7. Hematopoiesis and differentiation.
8. Regulation of the immune response: Activation of B and T-lymphocytes, Cytokines, T-cell regulation, MHC restriction, Immunological tolerance.
9. Cell-mediated cytotoxicity: Mechanism of cytotoxic T cells and NK cells mediated target cell lysis, Antibody dependent cell mediated cytotoxicity, macrophages mediated cytotoxicity.
10. Hypersensitivity.
11. Autoimmunity.
12. Transplantation.
13. Immunity to infection and tumours.

Suggested readings:

- Hannigan, 2008, Immunology.
- Kuby, 1994, Immunology.
- Roitt&Maled, 2007, Immunology.
- Richard Coico,Geoffery, 2008, Immunology A short course.

I.2. Animal Cell Culture - BTPR 102 Credits: 3

1. Introduction to the balanced salt solutions and simple growth medium. Brief discussion on the chemical, physical and metabolic functions of different constituents of culture medium.
2. Biology and characterization of the cultured cells.
3. Measuring parameters of growth.
4. Basic techniques of mammalian cell cultures *in vitro*.
5. Serum & protein free defined media and their applications.
6. Measurement of viability and cytotoxicity.
7. Apoptosis
8. Cell synchronization
9. Cell transformation.
10. Applications of animal cell culture: cell culture based products, vaccines, Hybridoma technology and monoclonal antibodies, stem cells and their applications.
11. Organ, organotypic and histotypic cultures.

Suggested readings:

- Freshney, 1994, Culture of animal cells.

I. 3. Genetics and Molecular Biology - BTPR 103 Credits: 3

1. Introduction to cell division, Mendelian Laws and physical basis of inheritance, dominance and its molecular basis.
2. Basics of gene interaction, cis-trans-test and complementation test, lethal genes, polygenic traits, linkage and gene maps.
3. Double helix: Physico-chemical considerations.
4. Organization of prokaryotic and eukaryotic genomes, supercoiling, repetitive DNA.
5. DNA replication: Mechanism of replication of Prokaryotic & Eukaryotic Chromosome.
6. Mutation: Types and molecular mechanisms of mutations, mutagens, DNA Repair.
7. Transposition: Mechanisms of transposition, role of transposons in mutation.
8. Gene transfer in prokaryotes: Transformation, conjugation, transduction, construction of genetic maps in bacteria.
9. Recombination: Homologous and site - specific recombination.
10. Gene expression in bacteria: Transcription and its regulation; operons, attenuation, anti-termination and anti-sense controls.
11. Prokaryotic translation machinery, mechanism and regulation of translation.
12. Gene expression in eukaryotes: Transcription, general and specific transcription factors, regulatory elements and mechanism of regulation, processing of transcripts.

Suggested readings:

- Julio Lodge, 2007, Gene cloning.
- S Surzycki, 2000, Basic techniques in Molecular Biology.
- Helen Kreuzer, 2008, Molecular Biology & Biotechnology: A Guide for student.
- Jun Ma, 2006, Gene expression & regulation.
- Cooper, 2007, The Cell : A Molecular Approach.
- T.A.Brown, 2006, Genome 3.
- Alberts/Watson, 2008, Molecular Biology of the cell.
- HD Kumar, 2010, Molecular & Synthetic Biology
- Snustad, 2010, Principles of genetics

I. 4. Genetic Engineering - BTPR 104 Credits: 3

1. Restriction endonucleases, Modification methylases and other enzymes needed in genetic engineering.
2. Cloning vectors: Plasmids and plasmid vectors, Phages and Phage Vectors,phagemids, cosmids, artificial chromosome vectors (YAC,

BAC), CHEF analysis.Animal virus derived vectors - SV40 and retroviral vectors.

3. Molecular cloning: Recombinant DNA techniques, construction of genomic DNA and cDNA libraries, screening of recombinants.
4. Expression strategies for heterologous genes.
5. DNA analysis: labeling of DNA and RNA probes. Southern and fluorescence *in situ* hybridization, DNA fingerprinting, chromosome walking.
6. Techniques for gene expression: Northern and Western blotting, gel retardation technique, DNA footprinting, Primer extension, Sl mapping, Reporter assays.
7. Sequencing of DNA, chemical synthesis of oligonucleotides; techniques of *in vitro* mutagenesis. Site-directed mutagenesis, gene replacement and gene targeting.
8. Polymerase chain reaction and its applications.
9. Use of transposons in genetic analysis: Transposon and T-DNA tagging and its use in identification and isolation of genes.
10. Applications of genetic engineering: Transgenic animals, production of recombinant pharmaceuticals, gene therapy, disease diagnosis.
11. Biosafety regulation: Physical and Biological containment.

Suggested readings:

- KrebsLewin's, 2010, Genes X.
- T A Brown, 2008, Gene cloning &DNA analysis.
- Hartl, 2009, Genetics analysis of genes and genomes.
- Dale, 2007, From genes to genomes.
- Snustad, 2010, Principles of genetics.

I. 5. Biochemistry and Biophysics - BTPR 105 Credits: 3

1. Carbohydrates; Glycolysis, Gluconeogenesis, Krebs' Cycle, Electron transport chain, Oxidative Phosphorylation.
2. Fatty acids; general properties and ß- oxidation.
3. Nitrogen metabolism: Amino acids (general properties); Amino acid sequencing and composition; end group analysis.
4. Proteins: Protein structure (primary, secondary, tertiary &quaternary), Globular, Fibrous proteins; Ramachandran plot, Circular Dichroism, Hydrophobic and hydrophilic interactions. PAGE, SDS-PAGE, Diagonal Electrophoresis, MALDI.
5. Protein folding (Introduction / Tools to study folding – unfolding phenomenon)
6. DNA - protein interactions; DNA-drug interactions.

Suggested readings:

- Makee, 2009, Biochemistry.
- Wilson & Walker, 2008, Principle of Biochemistry.
- Lehninger, 2008, Principles of Biochemistry.
- Voet&Voet, 2008, Principles of Biochemistry.
- Devlin, 2006, Text Book of Biochemistry.
- M Cambell, 2007, Biochemistry.

I. 6. Enzymology and Enzyme Technology - BTPR 106 Credits: 3

1. Classification and nomenclature of enzymes.
2. Isolation, purification and large-scale production of enzymes.
3. Coenzymes and Cofactors.
4. Steady state kinetics: Methods for estimation of rate of enzyme catalyzed reaction with special reference to Michaelis-Menten equation. Effects of substrate, temperature, pH and inhibitors on enzyme activity and stability.
5. Mechanism of enzyme action (active site, chemical modification) and regulation (Zymogens, Isozymes).
6. Enzyme engineering.
7. Applications of enzymes.
8. Immobilization of Enzymes.

Suggested readings:

- O connor David, 2008, Proteomics.
- Price & Stevens, 2006, Fundamentals of enzymology.

I. 7. Cell Biology - BTPR 107 Credits: 3

1. Cell membranes: Methods and techniques to study Composition, organization, mobility of lipids and proteins in membrane, Role of temperature on lipid mobility and fluidity, Asymmetry study of lipid, Cell fusion, FRAP & SPT techniques, control of mobility, determination of sidedness of protein, hydropathy plot, helix packing determination
2. Transport across bio membranes: Facilitated transport, group translocation, Active transport, Na+-K+ ATPase pumps, partition coefficient and membrane permeability, Ligand gated channels and voltage gated channels.
3. Cytoskeleton: Composition, organization and functions of microfilaments, microtubules, intermediate filaments and associated proteins, actin and tubulins motor proteins.
4. Basic concept of signal transduction: Kinases, phosphatases, MAPkinase, GPCR, G-protein cycle.
5. Cell adhesion molecules: Interaction of cells with non-cellular substrate, and interaction of cells with other cells, cell junctions & extra-cellular matrix.
6. Cell cycle and its control.
7. Biology of cancer cells and process of oncogenesis

Suggested readings:

- B Lewin, 2007, Cells.
- Thomas Pollard, 2002, Cell Biology.
- Berk Lodish, 2008, Molecular cell Biology.
- Gerald Karp, 2008, Cell & Molecular Biology.
- Cooper, 2007, The Cell a Molecular Approach.
- Karp, 2010, Cell Biology.

I. 8. Plant Biotechnology - BTPR 108 Credits: 3

1. Tissue culture media, Initiation and maintenance of callus and suspension cultures; single cell clones.
2. Biochemical production.
3. Totipotency: Organoganesis; somatic embryogenesis; transfer and establishment of whole plants in soil (hardening).
4. Rapid clonal propagation and production of virus -free plants.
5. *In vitro* pollination; embryo culture and embryo rescue.

6. Protoplast fusion, selection of hybrid cells; symmetric and asymmetric hybrids, cybrids.
7. Nuclear cytology of cultured plant cells and somaclonal variations.
8. Production of haploid plants and their utilization.
9. Cryopreservation and slow growth for germ plasm conservation.
10. Gene transfer in nuclear genome and chloroplasts; *Agrobacterium*-mediated gene transfer, direct gene transfer, antibiotic marker-free transgenics.
11. Transgenic plants: insect resistance, virus resistance, abiotic stress tolerance, longer shelf life (including strategies for suppression of endogenous genes), male sterility, enhanced nutrition (golden rice), edible vaccines.
12. Molecular markers: RFLP, RAPD, AFLP, applications of molecular markers

Suggested readings:

- G Philips, 1996, Plant cell Tissue & organs culture.
- Mangal, 2000, DNA markers in plant interaction.
- Iqbal Ahmed, 2008, Plant- Bacteria Interaction.

I. 9. Microbiology - BTPR 109 Credits: 3

1. History of Microbiology, Discovery of the microbial world.
2. Isolation, pure culture techniques, Methods of sterilization and Enrichment culture techniques.
3. Bacterial identification, nomenclature and classification, New approaches to bacterial taxonomy / classification including ribotyping and ribosomal RNA sequencing.
4. General structure and features all group of bacteria and cyanobacteria, Rickettsias, Chlamydias and Mycoplasmas,
   Archaea : Archaebacteria and extremophilic microbes – their biotechnological potentials
5. The definition of growth, growth curve, measurement of growth and growth yields, Culture collection and maintenance of cultures.
6. Different modes of nutrition in bacteria, Sulfate reduction, Nitrogen metabolism – nitrate reduction, nitrifying and denitrifying bacteria, Nitrogen fixation and Microbes used as biofertilizer.
7. Viruses : Classification, morphology and composition of viruses in general,
   Plant viruses (TMV, Gemini Virus), Animal viruses (baculoviruses),
   Bacteriophages : Lambda, ϕX 174, cyanophages,
8. Viroids and Prions.

Suggested readings:

- Peppler, 2008, Microbial technology Vol I &I I.
- Mark Whalis, 2008, Principles of modern microbiology.
- Black, 2008, Microbiology Principles & Applications.
- Jeffery, 2004, Fundamentals of Microbiology.
- Prescott, 2003, Microbiology.
- Eldor A Paul, 2007, Soil Microbiology ,Ecology & Biodiversity.
- S J Booth, 2010, Microbiology Pearls of wisdom.
- Pomerville, 2010, Alcamos Fundamentals of Microbiology.
- Wheelir, 2009, Principles of Modern Microbiology.

II Semester

II. Practical work/dissertation, seminar presentation, book review etc.**BTPR 201** -**4 credits**

The courses for these 4 credits will be include courses related to practical work, dissertation, seminar presentation, book review etc. (**to be conducted in the concerned lab of the allotted supervisor**) decided by the RPC of the concerned candidate.