FACULTY OF LIFE SCIENCES

SYLLABUS

For

Bridge Course in BIOTECHNOLOGY

(Under Credit Based Continuous Evaluation Grading System)
(Semester: III-IV)

Session: 2016-17

GURU NANAK DEV UNIVERSITY AMRITSAR

Bridge Course (Semester System)
(Credit Based Continuous Evaluation Grading System)

SCHEME OF COURSE

Semester – III

Course No.	C/E/I	Course Title	L	T	P	Total Credits
BTL501	C	Fermentation Technology	3	0	0	3
BTL502	C	Genetic Engineering-Applications	3	0	0	3
BTP522	C	Lab in Bioprocess Engineering &Technology	0	0	4	4
BTP523	C	Lab in Genetic Engineering	0	0	4	4
BTL531	E	Advances in Plant Biotechnology	3	0	0	3
BTL532	E	Medical Biotechnology	3	0	0	3
	I	Any one of the courses to be offered from outside the department	3	0	0	3
		Total Credits	**15**	**0**	**8**	**23**

Semester – IV

Course No.	C/E/I	Course Title	L	T	P	Total Credits
BTL451	C	Plant Tissue Culture	3	0	0	3
BTL452	C	Animal Tissue Culture	3	0	0	3
BTL453	C	Molecular Biology	3	0	0	3
BTL454	C	Genetic Engineering- Tools and Techniques	3	0	0	3
BTL455	C	Bioprocess Engineering & Technology	3	0	0	3
BTL456	C	Introduction to Bioinformatics	3	0	0	3
BTP471	C	Lab in Plant Tissue Culture	0	0	4	4
BTP472	C	Lab in Immunology & Animal Tissue Culture	0	0	4	4
	I	To be offered from outside the department	3	0	0	3
		Total Credits	**21**	**0**	**8**	**29**

Bridge Course (Semester – III)
(Credit Based Continuous Evaluation Grading System)

BTL 501: FERMENTATION TECHNOLOGY

Credits (3-0-0)

UNIT-I

Introduction

Introduction to Fermentation processes, Types of fermentation processes, batch fermentation processes and its kinetics, plug flow fermentation process and its kinetics, continuous fermentation processes and its kinetics, Fed batch fermentation processes and its kinetics, factors affecting fermentation processes.

UNIT-II

Isolation & Screening

Isolation, Screening, characterization and preservation of industrially important micro organisms, growth and production media, isolation & screening methods, improvement program of industrial microorganisms, mutants and mutational program for industrial micro organisms, recombinant of industrial micro organisms, preservation and maintenance of industrial micro organisms, quality control of preserved industrial micro organisms.

UNIT-III

Media for Industrial Fermentation

Introduction, typical media, medium formulation for growth and production, energy source, carbon source, nitrogen source, minerals, growth and production factors. Oxygen requirement, antifoam, medium optimization.

UNIT-IV

Down stream Processing

Recovery and purification of fermentation products, removal of microbial cells, cell aggregation and flocculation, foam separation, precipitation, filtration, different types of filters and filter aids, industrial centrifugation and industrial centrifuges, basket centrifuge, tubular bowl centrifuge, solid bowl centrifuge, multi chamber centrifuge, disc bowl centrifuge,. Cell disruption: physical method, chemical method, liquid-liquid extraction, aqueous two phase extraction, super critical fluid extraction chromatography, membrane separation processes, Drying and crystallization.

UNIT-V

Effluent Treatment and Fermentation Economics

Disposal, treatment processes, physical chemical and biological treatments, aerobic processes. Trickling filters, towers, biological aerated filters (BAFs), rotating drums, fluidized bed system, activated sludge processes, anaerobic treatment, up flow anaerobic sludge blankets (UASB), Byproducts, fermentation economics & market potential.

Books:

1. Principles of Fementation Technology, Peter F. Stanbury; A. Whitaker; S.J. Hall. Aditya Books (P) Ltd. New Delhi 2009.
2. Principles of Microbes and Cell Cultivation. S.J. Pirt. Blackwell Scientific Publications, Oxford 1999.
3. M.L. Shuler; F.Kargi; Bioprocess Engineering, Basic concepts. Prentis Hall. 2009.
4. J.E. Bailey & D.F. Olis; Biochemical Engineering Fundamentals McGraw Hill 2008.
5. B. Atkinson Biochemical Reactors Mac Millan Press 2008.
6. B. Atkinson Biochemical Engineering and Biotechnology Hand Book Mc Millan Press 2009.
7. J.M. Lee Biochemical Engineering Prentis Hall 2008.

Bridge Course (Semester – III)
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BTL 502: GENETIC ENGINEERING–APPLICATIONS

Credits (3-0-0)

UNIT – I

Plant Transformation technology: The basis of tumour formation, hairy root, features of T1 and R1 plasmids, mechanisms of DNA transfer, role of virulence genes, use of T1 and R1 as vectors, binary vectors, use of 35S and other promoters, genetic markers, use of reporter genes, reporter gene with introns, methods of nuclear transformation, viral vectors and their applications, multiple gene transfers, vectorless or direct DNA transfer, particle bombardment, electroporation, microinjection. Transgene stability and gene silencing. In planta transformation, transgene validation.

UNIT – II

Applications of plant transformation for productivity and performance: Herbicide resistance for phosphoinothricin, glyphosate, sulfonylurea, atrazine; Insect resistance: Bt Genes, non-Bt like protease inhibitors, alpha amylase inhibitor; Virus resistance: coat protein mediated, nucleocapsid gene; Disease resistance; chitinase, 1-3 beta glucanase, RP antifungal proteins, thionines, PR proteins; Nematode resistance, Long shelf life of fruits and flowers: use of ACC synthase, poly-galactouranase, ACC oxidase; Male sterile lines: bar and barnase systems; Carbohydrate composition and storage: ADP glucose pyrophosphatase, terminator gene technology.

UNIT – III

Molecular pharming (farming): edible vaccines, therapeutic proteins, Nutritional quality: golden rice, protein, vitamins. T-DNA & transposon tagging, promoter trapping, activation tagging. Chloroplast transformation: advantages, vectors, success with tobacco and potato;

UNIT – IV

Molecular marker-aided breeding: RFLP maps, linkage analysis, RAPD, SSLP markers, STS, microsatellites, SCAR (sequence characterized amplified regions), TE anchors, SSCP (single strand conformational polymorphism), AFLP, QTL, map-based molecular marker assisted selection, Application of RFLP in forensic, disease prognosis, genetic councelling, pedigree, varietal analysis, etc., animal trafficking and poaching, germplasm maintenance, taxonomy and biodiversity.

UNIT-V

Transgenic applications of Trehalose, Proline, NAC, CBF, HVAI, HSF, Na-H antiporter.

Text/References

Books Recommended:

1. Gupta, P. K. (1996). Elements of Biotechnology, Rastogi and Co., Meerut.
2. Henry, R. J. (1997). Practical Applications of Plant Molecular Biology, Chapman and Hall.
3. Chawla, H.S.(1998). Biotechnology in Crop Improvement, International Book Distributing Company.
4. Research Papers.

Bridge Course (Semester – III)
(Credit Based Continuous Evaluation Grading System)

BTP 522: LAB IN BIOPROCESS ENGINEERING & FERMENTATION TECHNOLOGY

Credits: (0-0-4)

- Bioreactors assembling and dismantling.
- Sterilization of fermentor and formentation media.
- pH probe standardization.
- Dissolve oxygen probe standardization.
- Determinations of thermal death point (TDP) and thermal death time (TDT) of micro organisms for designing of sterilization.
- Study the effect agitation on aeration and determination of KLa volumetric oxygen transfer rate in the bioreactor by dynamic gassing out technique.
- Isolation screening and characterization of cellulase producing micro organisms.
- Isolation screening ad characterization of alkaline protease producing micro organisms.
- Cell immobilization and study the bio reaction enzyme kinetics before and after immobilization.

Book:

1. B. Atkinson Biochemical Engineering and Biotechnology Hand Book Mac Millan Press 2009

Bridge Course (Semester – III)
(Credit Based Continuous Evaluation Grading System)

BTP 523: LAB IN GENETIC ENGINEERING

Credits (0-0-4)

PRACTICAL

- Isolation of genomic DNA from plant tissues.
- Isolation of genomic DNA from *E. coli* cells.
- Spectrophotometric analysis of DNA.
- Restriction digestion of DNA.
- Separation of digested fragments by agarose gel electrophoresis.
- Transfer of resolved DNA fragments from agarose gel to nylon/nitrocellulose membrane.
- Hybridization of nylon/nitrocellulose blots.
- Isolation of plasmid.
- Making competent cells of *E.coli*.
- Transformation of competent *E.coli* cells.
- Cloning of foreign DNA insert in plasmid (PET Vector).
- Isolation of total RNA.
- Expression of fusion protein (His-tagged/MBD-tagged)
- PCR.

Book Recommended:

1. Maniatis, T., Fritch, E.F. and Sambrook, J. (2001). Molecular cloning 3rd ed.: A laboratory manual, Ist edition. Cold Spring Harbour Laboratory, Cold Spring Harbour, New York.

Bridge Course (Semester – III)
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Elective Paper

BTL 531: ADVANCES IN PLANT BIOTECHNOLOGY

Credits (3-0-0)

UNIT-I

Biotechnological Advances in Plant Seed Development and Germination

Cellular and Molecular Biology of embryogenesis in dicotyledonous plants, hormonal regulation of seed development; control of seed maturation and germination, biotechnological approaches for altering seed composition

UNIT-II

Hairy Root Research: Recent Scenario and Exciting Prospects

Production of hairy root cultures, hairy roots for high-value metabolite production, metabolic engineering of bioactive substances in plant hairy root culture, application of hairy root in phytoremediation, Scale-up process.

UNIT-III

Gene Silencing Techniques and Crop Improvement

Overview of different strategies for gene silencing, RNA interference, construction of RNA interference vectors, applications of RNA interference in crop improvements

UNIT-IV

Reactive Oxygen Species (ROS) in Plants

Origins of the reactive oxygen species (ROS) network, the dynamics of ROS signaling, networking of ROS signaling with other signaling pathways, ROS in biotic and abiotic stress, ROS in plant growth and development.

UNIT-V

Hormonal Regulation of Plant Growth and Development

Signaling pathways of auxin and brassinosteroid. Interplay of different hormones for plant growth and development.

Books Recommended:

1. Cellular and Molecular Biology of Plant Seed Development. Larkins, Brian A.; Vasil, Indra K. (Eds.), Vol. 4, 1997, ISBN 978-0-7923-4645-6
2. Mei-Liang Zhou, Xue-Mei Zhu, Ji-Rong Shao,Yi-Xiong Tang & Yan-Min Wu (2011) Production and metabolic engineering of bioactive substances in plant hairy root culture. Appl Microbiol Biotechnol 90:1229–1239
3. Klaus Apel and Heribert Hirt (2004) Reactive Oxygen Species: Metabolism, Oxidative Stress, and Signal Transduction. Annu. Rev. Plant Biol. 2004. 55:373–99
4. Ron Mittler, Sandy Vanderauwera, Nobuhiro Suzuki, Gad Miller, Vanesa B. Tognetti, Klaas Vandepoele, Marty Gollery, Vladimir Shulaev, Frank Van Breusegem (2011) ROS signaling: the new wave? Trends in Plant Science. 16 (6), 300-309
5. Matthew, L. (2004), RNAi for plant functional genomics, Comparative and Functional Genomics, 5, 240-244.
6. Umesh Balkrishna Jagtap, Ranjit Gajanan Gurav and Vishwas Anant Bapat Role of RNA interference in plant improvement. Naturwissenschaften (2011) 98:473–492
7. William M Gray (2004) Hormonal Regulation of Plant Growth and Development. PLoS Biology. 2 (9) e311
8. Stephen Depuydt and Christian S. Hardtke (2011) Hormone Signalling Crosstalk in Plant Growth Regulation. Current Biology 21: R365–R373
9. Research Papers.

Bridge Course (Semester – III)
(Credit Based Continuous Evaluation Grading System)

Elective Paper

BTL 532: MEDICAL BIOTECHNOLOGY

Credits: (3-0-0)

UNIT-I

Cellular therapy; Stem cells: definition, properties and potency of stem cells; Sources: embryonic and adult stem cells; Concept of tissue engineering; Histotypic and Organotypic culture for tissue engineering; Immunotherapy: Cancer immunotherapy; Role of cytokine therapy in cancers; Genetically engineered stem cells in cancer treatment

UNIT-II

Monoclonal antibodies and their role in cancer; Role of recombinant interferons; Immunostimulants; Clinical transplantation immunology and immunosuppressive therapy; Vaccine development; recombinant vaccines and clinical applications.

UNIT-III

Gene therapy; Intracellular barriers to gene delivery; Overview of inherited and acquired diseases for gene therapy; Retro and adeno virus mediated gene transfer; Liposome and nanoparticles mediated gene delivery

Recombinant therapy; Clinical applications of recombinant technology; Erythropoietin; Insulin analogs and its role in diabetes; Recombinant human growth hormone; Streptokinase and urokinase in thrombosis; Recombinant coagulation factors

UNIT-IV

Genetic markers-Biomarkers in early drug development; Biomarkers in Clinical development; Biomarkers for molecular Diagnostics- example of cancer biomarkers; IVET

UNIT-V

Drugs; Types of Drugs - examples of latest drugs; steps in drug designing, HTS, In silico drug designing, structure based drug designing, methods of docking concept of ADME metabolism & Drug Excretion; QSAR; Drug Legislation & safety.

Books Recommended:

1. Spier, R.R. and Griffttths, J.B. (1994). Animal Cell Biotechnology, 6th Ed., Academic Press, London.
2. Krogsgaard-larsen P. , Liljefors T., Madsen U. and Larsen K, Liljefors T. Madsen U. (2002). Textbook of Drug Design and Discovery, Taylor and Francis Publications, Washington D.C.
3. Palson, O.B. and Bhatia, N.S. (2009). Tissue Engineering. Dorling Kindersley (India) Pvt. Ltd.
4. Robert L. and other (2009) .Essentials of Stem Cell Biology. 2nd Ed. Academic Press, London.
5. Research Papers and Review Articles

Bridge Course (Semester IV)
(Credit Based Continuous Evaluation Grading System)

BTL 451: PLANT TISSUE CULTURE

Credits (3-0-0)

Unit – I

Concepts & basic techniques in tissue culture, Micropropagation, stages of micropropagation, direct and indirect regeneration, Organogenesis & somatic embryogenesis, Factors affecting Organogenesis & somatic embryogenesis, Production and application of artificial seeds. Importance of variability, somaclonal and gametoclonal variations, practical application of somaclonal variations.

Unit – II

Embryo culture / embryo rescue and ovary culture. Endosperm culture, production of triploids, anther and pollen culture, Factors affecting anther and pollen culture, Significance of haploids in agriculture.

Unit – III

Protoplast isolation, fusion & culture, somatic hybridization, selection of hybrid cells and regeneration of hybrid plants, symmetric and asymmetric hybrids, cybrids and role of protoplast culture and somatic hybridization in improvement of crop plants.

Unit – IV

Initiation and maintenance of callus and suspension cultures, single cell clones, Plant secondary metabolites a general account, important pathways of secondary metabolite production (phenylpropanoid pathway and shikimate pathway etc), Regulation and accumulation of secondary metabolites, Biotransformation and elicitation.

Unit – V

Freeze preservation & cryopreservation in germplasm storage, factors affecting revival of frozen cells, slow growth & DNA banking for germplasm conservation.

Books Recommended:

1. George, E.F. (1993). Plant Propagation by Tissue Culture, 2nd ed., Part-I, The Technology, Exegetics Ltd
2. Razdan, M. K. (1994). An Introduction to Plant Tissue Culture. Oxford & IBH Publishing Co., New Delhi.
3. Bhojwani, S.S. and Razdan, M.K. (1996). Plant Tissue Culture. Theory and Practice, Elsevier.
4. Tong-Jen, Fu, Gurmeet Singh & Wayne R. Curtis. Plant Cell & Tissue Culture for the Production of Food Ingredients. Kluwer Acad, N.Y.
5. Ramawat, K.G. and Merillon, J.M. (1999). Biotechnology: Secondary Metabolites, Science Publishers, U.S.
6. Purohit, S. S. (2000). Biotechnology Fundamentals & Application. 3rd ed., Agrobios (India), New Delhi.

BTL 452: ANIMAL TISSUE CULTURE

Credits: (3-0-0)

UNIT – I

Concept of aseptic techniques in ATC; design and layout of ATC lab, Equipment for ATC lab. Laboratory safety and Biohazards, balanced salt solution and tissue culture media.

Unit-II

Detection of contamination, preservation, storage and shipment of cells. Growth of cells in the serum free hormone(s) supplemented medium, Role of CO2 in culture medium.

UNIT – III

Dispersion and disruption of tissue, monolayer and suspension culture techniques, measurement of growth and viability of cells in culture, maintenance of cultured cell line, primary and established cell line cultures, cell separation.

UNIT – IV

Cell culture characteristics, scale up methods for propagation of anchorage dependent and suspension cell culture, concept of Bioreactors for mass culture of mammalian cells, microcarrier culture. Three dimensional culture system and tissue engineering.

UNIT – V

Cell synchronization, cell transformation, cell immobilization techniques, Cell cloning and micromanipulation, animal cloning.

Books Recommended:

1. Spier, R. R. and Griffiths, J. B. (1990). Animal Cell Biotechnology, Academic Press, London.
2. Gareth, E. J. (1996). Human Cell Culture Protocols, Humana Press.
3. Julio, E., Celis (1998). Cell Biology-A Laboratory Hand Book, Vol. I-IV, 2nd Ed., Academic Press, New York.
4. Butler, M. (2004). Animal Cell Technology, 2nd Ed., BIOS Scientific Publishers, U.K.
5. Freshney, R. T. (2006). Culture of Animal Cells, 5th Ed., John Wiley and Sons, New York.

Bridge Course (Semester IV)
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BTL 453: MOLECULAR BIOLOGY

Credits (3-0-0)

Unit – I

DNA: the vehicle of inheritance, chemical structure & base composition of nucleic acids, A, B and Z- DNA, double helical structures, forces stabilizing nucleic acid structure, super coiled DNA, properties of DNA, nucleic acid hybridization – cot curves.

Unit – II

DNA replication, Repair and Recombination: Replication initiation, elongation and termination in prokaryotes & eukaryotes, enzymes and accessory proteins involved in DNA replication, Fidelity; DNA repair- photoreactivation, nucleotide and base excision repair, mismatch repair, SOS response, gene amplification, mobile genetic elements.

Unit – III

Prokaryotic transcription; transcription unit, promoters: constitutive and inducible, initiation, termination- rho dependent and independent. Eukaryotic transcription, promoters for RNA polymerase I, II and III, transcription factors, regulatory elements & mechanism of transcription regulation, post-transcriptional modifications: processing of hnRNA, rRNA & tRNA; 5'cap formation, 3'-end processing, polyadenylation and splicing.

Unit – IV

Genetic code, prokaryotic & eukaryotic translation, the translation machinery, isoaccepting tRNA, wobble hypothesis, mechanism of initiation, elongation & termination, ribosome recycling factor, tm RNA, regulation of translation, co & post translation modification of proteins and intracellular protein targeting import into nucleus, mitochondria and peroxiome, non-ribosomal polypeptide synthesis, prions.

Unit – V

Regulation of gene expression in prokaryotes and eukaryotes; (operon concept; lac, trp and ara operons), RNA interference, Viral & cellular oncogenes, tumor suppressor genes from humans, structure, function & mechanism of action of p53 tumor suppressor proteins, Molecular mechanism of antisense molecules, ribozymes, applications of antisense & ribozyme technologies.

Books Recommended:

1. Rawn, J. D. (1989). Biochemistry, 2nd edition, Neil Patterson Publications, U. S. A. , North Carolina,
2. Damal, J., Lodish, H., and Baltimore, D. (1990). Molecular Cell Biology, 2nd ed., Scientific American Books, Distributed by W. H. Freeman and Co., New York.
3. Adams, R. L. P., Knowler, J. T., and Leader, D. P. (1992). The Biochemistry of Nucleic acids, 11th ed., Champman and Hall, The New York/London/Tokyo/Melbourne/Madras.
4. Stryer, L. (1995). Biochemistry, 4th ed., W. H. Freeman and Co., New York.
5. Nelson, D. L. & Cox, M. M. (2005). Lehninger Principles of Biochemistry, 4th ed., Worth Publishers, New York.
6. Watson J., Baker T., Bell S., Gann A, Levine M and Loscik R. (2008). Molecular Biology of the Gene. 6th Ed. Pearson Education.
7. Krebs J.E., Goldstein E.S. and Kilpatrick ST (2009), Lewin's Genes, Jones and Bartlett Publishers, U.K.

Bridge Course (Semester IV)
(Credit Based Continuous Evaluation Grading System)

BTL 454: Genetic Engineering-Tools & Techniques

Credits (3-0-0)

Unit-I

Restriction Enzymes; DNA ligase, Klenow enzyme, T4 DNA polymerase, Polynucleotide kinase, Alkaline phosphatase; Cohesive and blunt end ligation; Labeling of DNA: Nick translation, Random priming, Radioactive and non-radioactive probes,

Unit-II

Plasmids; M13 mp vectors; pUC19 and Bluescript vectors, Phagemids; Lambda vectors; Insertion and Replacement vectors; Cosmids; Artificial chromosome vectors (YACs; BACs); Expression vectors; pMal; GST; pET-based vectors; Protein purification; His-tag; GST-tag; MBP-tag etc.; Intein-based vectors; Yeast vectors, Shuttle vectors, siRNA technology.

Unit-III

Expression strategies for heterologous genes: vector engineering, codon optimization, host engineering, in vitro transcription & in vitro translation, expression in bacteria, expression in yeast, Inclusion bodies; Methodologies to reduce formation of inclusion bodies.

Unit-IV

Linkers; Adaptors; Homopolymeric tailing, strategies for cDNA libraries; Transformation; Northern, Southern and Colony hybridization,Southwestern and Far-western cloning; Phage display; cloning differentially expressed genes (mRNA differential display and subtractive cloning). DNA-Protein Interactions (Electromobility shift assay; DNaseI footprinting)

Unit-V

PCR and Its Applications Primer design; Fidelity of thermostable enzymes (Taq & Pfu polymerases); DNA polymerases; Types of PCR – multiplex, nested, reverse transcriptase, real time PCR, touchdown PCR, hot start PCR, colony PCR, cloning of PCR products; PCR in gene recombination; SOEing; Site specific mutagenesis; deletion; addition;

Books Recommended:

1. S.B. Primrose, R.M. Twyman and R.W.Old; Principles of Gene Manipulation. 6th Edition, S.B.University Press, 2001.
2. J. Sambrook and D.W. Russel; Molecular Cloning: A Laboratory Manual, Vols 1-3, CSHL, 2001.
3. Brown TA, Genomes, 3rd ed. Garland Science 2006
4. Selected papers from scientific journals.
5. Technical Literature from Stratagene, Promega, Novagen, New England Biolab etc.

BTL 455: BIOPROCESS ENGINEERING & TECHNOLOGY

Credits (3-0-0)

Unit – I

Introduction: Historical development from Petri-plate, shake flask, Lab level bioprocess, pilot level to industrial level bioprocess engineering. Scale up of bioprocesses parameters. Growth parameters, growth rate, specific growth rate and biomass doubling, degree of multiplication, growth yield, Ydx/ds, Ydx/do2, metabolic quotient, effect of substrate concentration on growth rate, Monod growth relation, saturation constants and its importance, biomass estimation.

Unit-II

Bioreactor Designing Introduction, Basic function of a bioreactor, microbial, animal and plant bioreactors. Aspectic operation and contamination. Sterilization of bioreactors, Body construction, Temperature control and measurement. Aeration and agitation, impellers, Stirrer, glands and bearings, packed gland seal, mechanical seal, magnetic drives, Baffles, different types of spargers, different ports, temperature probes. Dissolve oxygen prope. Valves and stream traps : Gate valves, globe valves. Piston valves, needle valves, plug valves, ball valves, butterfly valves, pinch valve, Diaphragm valves, check valves, pressure control valves, pressuer reduction and retaining valves, safety valves, steam traps, bioreactor vessels, Wlad hof-type acetators and cavitators, tower bioreactor, cylindroconical vessels, air lift bioreators, deep jet bioreactor, cyclone column, packed tower, rotating disc bioreactor. Animal cell bioreactors, stirred, air lift micro carrier, encapsulation, Hallow fibres chambers, packed glass bead and perfusion bioreactors.

Unit-III

Instrumentation and Control: Introduction, Methods of Measuring process variables, Temperature, Mercury and electrical resistant thermometers, Thermistors, temperature control, flow measurement and control : gasses and liquids, pressure measurement and control, foam sensing and control, inlet and exit gas analysis, pH and dissolve oxygen probes, pH measurement and control, carbon dioxide electrodes, on-line, in-line and off-line measurement and analysis. Ion specific sensors, enzyme and microbial electrodes, manual, automatic, proportional, integral and derivative controls. PID controls.

Unit – IV

Aeration and Agitation Introduction, The oxygen requirement for industrial bioreactors, oxygen demand and supply and balance between them, volumetric oxygen transfer, determination of Kla values, sulphite oxidation techniques, gassing out techniques: static method and dynamic method, oxygen balance method. Fluid rheology: Bingham plastic, pseudo plastic, Dilatants, Casson body. Factors affecting KLa values in bioreactors, the effect of medium rheology on KLa values, scale up and scale down of airation and agitation.

Unit – V

Sterilization Introduction, medium sterilization, design of batch sterilization process, del factor, sterilization cycle, Richards rapid method for design of sterilization cycles, batch sterilization, scale up of batch sterilization, continuous sterilization, sterilization of feed, sterilization of wastes, Filter sterilization, filter sterilization of media and air, Depth filters design, theory of depth filter.

Books Recommended:

1. Principles of Fementation Technology, Peter F. Stanbury; A. Whitaker; S.J. Hall. Aditya Books (P) Ltd. New Delhi 2009.
2. Principles of Microbes and Cell Cultivation. S.J. Pirt. Blackwell Scientific Publications, Oxford 1999.
3. M.L. Shuler; F.Kargi; Bioprocess Engineering, Basic concepts. Prentis Hall. 2009.
4. J.E. Bailey & D.F. Olis; Biochemical Engineering Fundamentals McGraw Hill 2008.
5. B. Atkinson Biochemical Reactors Mac Millan Press 2008.
6. B. Atkinson Biochemical Engineering and Biotechnology Hand Book Mac Millan Press 2009.
7. J.M. Lee Biochemical Engineering Prentis Hall 2008.

Bridge Course (Semester IV)
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BTL 456: INTRODUCTION TO BIOINFORMATICS

Credits (3-0-0)

Unit-I

Introduction to Bioinformatics: History of Bioinformatics, milestones, Genome sequencing Projects, Human Genome Project, objectives and applications of Bioinformatics.

Unit-II

Introduction to databases: Type and kind of databases, e.g. PUBMED, MEDLINE Nucleic acid and protein databases: GenBank, EMBL, DDBJ, SWISS PROT, INTERPRO, UNIPROT. Genome project TIGR database, SGD, PLASMODB Data format

Unit-III

Sequence alignment: Scoring matrices, PAM, BLOSUM, Local and global alignment concepts; Dot matrix sequence comparison; Dynamic programming; Needleman-Wunch algorithm, Smith- Waterman algorithm;

Unit-IV

Database searches for homologous sequences, FASTA and BLAST, PSSM searching, PSI-BLAST and PHI-BLAST, Multiple sequence alignment; Phyllogenetic analysis Motifs and Pattern Databases: PROSITE, Pfam, BLOCKS, PRINTS

Unit-V

Protein sequence analysis tools, secondary structure prediction, tertiary structure prediction homology modelling, fold recognition, ab initio methods structure visiualization and analysis tools, rasmol chimera spdviwer, Structure analysis Structural databases: PDB, PDBsum, NDB etc. SCOP, CATH

Books Recommended:

1. Cynthia Gibas & Per Jamesbeck, (2000). " Developing Bioinformatics Computer Skills," O' Rilley & Associates.
2. Campbell and Heyer, Discovering Genomics, Proteomics & Bioinformatics, 2nd Edition, Benjamin Cummings, 2002.
3. Bourhe P. E. and Weissig H. (2003). Structural Bioinformatics (Methods of structural Analysis). Wiley-Liss.
4. Mount D. W. (2004). Bioinformatics & Genome Analysis. Cold Spring Harbor Laboratory Press.
5. Wayne W. Danile(2004), Biostatistics: A foundation for Analysis in the Health Sciences, 8 th Edition Wiley.

BTP 471: LAB IN PLANT TISSUE CULTURE

Credits (0-0-4)

1. Laboratory design setup for PTC unit.
2. Preparation, sterilization of media (Liquid & solid).
3. Surface sterilization, sealing of cultures, sources of contamination and their check measures.
4. Organ explant culture and micropropagation techniques.
5. Callus induction, propagation and differentiation.
6. Histological study of callus cells.
7. Suspension cultures.
8. Nurse culture techniques.
9. To observe practically various forms of undesirable characteristics in cultures such as:
   i) Vitrification
   ii) Stunting of shoots
   iii) Abnormal embryoids.
   iv) Etiolated shoots.
10. Preparation of synthetic seeds and their shelf life studies.
11. Micrografting Techniques.
12. Acclimatization of in vitro raised plantlets.
13. Comparison of ex vitro and in vitro rooting with respect to % survival.
14. To culture shoots on liquid media and derive a comparative account with reference to solid media grown cultures.
15. Protoplast isolation and culture.
16. Agrobacterium mediated transformation of plant cells.

BTP 472: LAB IN IMMUNOLOGY & ANIMAL TISSUE CULTURE

Credits (0-0-4)

1) Total leukocyte count
2) Differential leukocyte count
3) Haemagglutination assay
4) Isolation of mononuclear cells from peripheral blood and viability test by dye exclusion method
5) Separation of serum from blood
6) Separation of peritoneal macrophages from mouse/rat
7) Double immunodiffusion test using specific antibody and antigen
8) Dot Immuno blot assay (DIBA)
9) ELISA
10) Polyacrylamide gel electrophoresis and western blotting
11) Separation and purification of antibodies from serum
12) Growth and maintenance of cell line(s)
13) Trypsinization method for recovery of cells from monolayer
14) Doubling time of a given cell line and cell cycle analysis by Flow Cytometry
15) Cytotoxic assay method for a given cell line and testing by trypan blue dye exclusion method
16) Immunohistochemical localization of proteins and imaging using Confocal Microscope

Books Recommended:

1. Gareth, E. J. (1996). Human Cell Culture Protocols, Humana Press.
2. Jones, G.E. (1996). Human Cell Culture Protocols. Humana Press, New York.
3. Julio, E. Celis (1998). Cell Biology-A laboratory hand book, vol. I-IV, 2nd ed., Academic Press, New York.
4. Celis, J.E. (1998). Cell Biology: A laboratory handbook Vol-I, Academic Press, U.K.
5. Patel, D.(2001). Separating Cells, BIOS, U.K.
6. Hay, F.C., Westwood, O.M.R. (2002). Practical Immunology, 4th ed., Blackwell Sciences, U.K.
7. Freshney, R.I.(2006). Animal Cell Culture 5th ed., Oxford University Press, USA.