FACULTY OF ENGINEERING

DEGREE OF DOCTOR OF PHILOSOPHY
IN
BIOTECHNOLOGY

DEPARTMENT OF BIOTECHNOLOGY

(REGULAR PROGRAMME)

CURRICULUM & SYLLABI
(2023 -2024)

Enable | Enlighten | Enrich
KARPAGAM
ACADEMY OF HIGHER EDUCATION
(Deemed to be University)
(Established Under Section 3 of UGC Act, 1956)

KARPAGAM ACADEMY OF HIGHER EDUCATION
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(Accredited with A+ Grade by NAAC in the Second Cycle)
COIMBATORE 641 021 INDIA

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Eachanari, Coimbatore-641 021. INDIA

FACULTY OF ENGINEERING

DEGREE OF DOCTOR OF PHILOSOPHY IN BIOTECHNOLOGY (Ph.D)

REGULAR PROGRAMME

REGULATIONS
(2023)

CHOICE BASED CREDIT SYSTEM

Phone: 0422- 6471113 – 5; Fax No : 0422 – 2980022, 2980023
Email :info@karpagam.com
Web: www.kahedu.edu.in

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Eachanari Post Coimbatore -641021, INDIA

FACULTY OF ENGINEERING

DOCTOR OF PHILOSOPHY (Ph.D.)

REGULATIONS 2023

These regulations are effective from the academic year 2023-2024 and applicable to the candidates admitted to Ph.D. during 2023-2024 and onwards.

I. ELIGIBILITY CRITERIA

First class or 55% marks (50% marks for SC/ST), in M.Tech degree in Biotechnology or in related disciplines.

II. MODE OF SELECTION

The guidelines as given in the Regulations for M.Phil.,/ Ph.D., of Karpagam Academy of Higher Education are applicable.

III. PROGRAMME STRUCTURE AND RESEARCH WORK

Upon successful completion of the degree, the candidate will be conferred with the degree of Doctor of Philosophy (Ph.D.) in Biotechnology under the Faculty of Engineering.

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PART – I COURSE WORK SYLLABUS FOR Ph.D COURSE IN BIOTECHNOLOGY (2023-2024)

SL.NO	TITLE OF THE COURSE	NO. OF SUBJECT	CREDIT	EXAM. HRS	MARKS
1	PAPER I	01	4	3	100
2	PAPER II	01	4	3	100
3	PAPER III	01	4	3	100
	TOTAL	03	12	9	300

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Eachanari Post Coimbatore -641021, INDIA

PART – I COURSE WORK SYLLABUS FOR Ph.D COURSE IN BIOTECHNOLOGY

(2023-2024)

23RBTE101 Research Methodology and Pedagogy 4H- 4C

Instruction Hours / Week: L: 4 T: 0 P: 0 Marks External: 100 Total: 100
End Semester Exam: 3 Hours

UNIT – I

The hallmarks of scientific research – Building blocks of science in research – Concept of Applied and Basic research – Quantitative and Qualitative Research Techniques – Concept of design Thinking-Need for theoretical frame work –Research Strategies – Ethics – code of conduct for research – Health and Safety - IPR.

UNIT – II

Research Events – Networks – Outreach Activities – Best Research Practices – Quality Assurance for Research – Journal Critiques - Laboratory and the Field Experiment – Internal and External Validity – Factors affecting Internal validity. Measurement of variables – Scales and measurements of variables – Validity testing of scales – Reliability concept in scales being developed – Stability Measures.

UNIT – III

Interviewing, Questionnaires, etc. Secondary sources of data collection. Guidelines for Questionnaire Design – Electronic Questionnaire Design and Surveys. Special Data Sources: Focus Groups, Static and Dynamic panels. Review of Advantages and Disadvantages of various Data-Collection Methods and their utility. Sampling Techniques – Probabilistic and non-probabilistic samples. Issues of Precision and Confidence in determining Sample Size. Hypothesis testing, Determination of Optimal sample size.

UNIT – IV

Introduction to Statistics – Probability Theories - Conditional Probability, Poisson Distribution, Binomial Distribution and Properties of Normal Distributions, Estimates of Means and Proportions; Chi-Square Test, Association of Attributes - t-Test –ANOVA- Standard deviation - Co-efficient of variations. Co-relation and Regression Analysis. Purpose of the written report - Concept of audience - Basics of written reports. Research Report: Types of reports- contents - styles of reporting - steps in drafting reports - editing the final draft - Evaluating the final draft.

UNIT – V

Objectives and roll of higher education – important characteristics of an effective lecture – Quality teaching and learning – lecture preparation – characteristics of instructional design – Methods of teaching and learning : large group – Technique – Lecture, Seminar, Symposium, Team Teaching, Project, Small group Technique – Simulation, role playing demonstration, Brain Storming, Case Discussion, assignment, methods of evaluation – Self Evaluation, student evaluation, Diagnostic testing and remedial teaching – Question Banking – Electronic media in education: e-learning researches – web based learning.

SUGGESTED READINGS:

1. Cooper, D. R., Schindler, P. S., & Sun, J. (2006). Business research methods (Vol. 9). New York: McGraw-Hill Irwin.
2. Sekaran, U., & Bougie, R. (2016). Research methods for business: A skill building approach. John Wiley & Sons.
3. Kothari, C. R. (2004). Research methodology: Methods and techniques. New Age International.
4. McBurney, D. H., & White, T. L. (2009). Research methods. Cengage Learning.
5. Ticehurst, G.W. & Veal, A.J. (2000). Business Research Methods, Managerial approach. Pearson Education.
6. Kumar Ranjit. (2005). Research Methodology. 2nd Edition. Pearson Education.
7. Thietart, R. A. (2001). Doing management research: a comprehensive guide. Sage.

23RBTE201 **Research and Publication Ethics** **4H- 4C**

Instruction Hours / Week: L: 4 T: 0 P: 0 **Marks External: 100** **Total: 100**
End Semester Exam: 3 Hours

UNIT I PHILOSOPHY AND ETHICS

Introduction to philosophy: definition, nature and scope, concept, branches - Ethics: definition, moral philosophy, nature of moral judgements and relations.

UNIT II SCIENTIFIC CONDUCT

Ethics with respect to science and research - Intellectual honest and research integrity – Scientific misconducts: falsification, fabrication, and plagiarism - Redundant publications: duplicate and overlapping publications, salami slicing - Selective reporting and misrepresentation of data.

UNIT III PUBLICATION ETHICS

Publication ethics: definition, introduction and importance - Best practices/standards setting initiatives and guidelines: COPE, WAME, etc. - Conflicts of interest - Publication misconduct: definition, concept, problems that lead to unethical behavior and vice versa, types - Violation of publication ethics, authorship and contributor ship - Identification of publication misconduct, complaints and appeals - Predatory publishers and journals- Reference management tools-Endnote and Mendeleys.

UNIT IV PUBLICATION MISCONDUCT

Group Discussions: Subject specific ethical issues, FFP, authorship - Conflicts of interest - Complaints and appeals: examples and fraud from India and abroad Software tools - Use of plagiarism software like Turnitin, Urkund and other open source software tools.

UNIT V - DATABASES AND RESEARCH METRICS

Databases: Indexing databases - Citation databases: Web of Science, Scopus, etc. Research Metrics: Impact Factor of journal as per journal citation report, SNIP, SJR, IPP, Cite Score - Metrics: h-index, g index, i10 index, altmetrics

UNIT VI DEVELOPMENT OF E-CONTENT & IPR

Integrated Library Management System (ILMS): e-journals – e-books – e-sjodhsindu – shodhganga – Database – e-content development – Learning Management System (LMS) – ePG Pathshala – CEC (UG) SWAYAM – MOOCs – NPTEL – NMEICT. IPR: Patent – copyrights – Trademark – Geographical Indication.

PRACTICE

Open Access Publishing

Open access publications and initiatives - SHERPA/RoMEO online resource to check publisher copyright and self-archiving policies - Software tool to identify predatory publications developed by SPPU - Journal finder/ journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer Journal Suggester, etc.

Suggested Readings

1. Best Practice Guidelines on Publishing Ethics: A Publisher's Perspective, Second Edition, 2014 John Wiley & Sons, Ltd.

2. Wager E. The Committee on Publication Ethics (COPE): Objectives and achievements 1997- 2012. Presse Med. 2012.

3. Carlson RV, Boyd KM, Webb DJ. The revision of the Declaration of Helsinki: Past, present and future. Br J Clin Pharmacol. 2004.

4. Kambadur Muralidhar, Amit Ghosh,& Ashok Kumar Singhvi "ETHICS in Science Education,Research and Governance",

5. Indian National Science Academy, New Delhi 2019.

6. Publishing Ethics: Academic Research, Cambridge University Press ,Version 2.0, May 2019.

23RBTE301 **Advances in Microbial Technology** **4H- 4C**

Instruction Hours / Week: L: 4 T: 0 P: 0 **Marks External: 100** **Total: 100**
End Semester Exam: 3 Hours

UNIT I

Fermentative metabolism and development of bioprocessing technology, processing and production of recombinant products; isolation, preservation and improvement of industrially important microorganisms.

UNIT II

Immobilization of enzymes and cells; Batch, plug flow and chemostat cultures; Computer simulations; Fed-batch and mixed cultures; Scale-up principles; Downstream processing etc.

UNIT III

Current advances in production of antibiotics, vaccines, and biocides; Steroid transformation; Bioreactors; Bioprocess engineering; Production of non-microbial origin products by genetically engineered microorganisms.

UNIT IV

Concept of prebiotics, probiotics and biosurfactants- applications of new tools of biotechnology for quality feed/food production, human and animal application; Microorganisms and proteins used in probiotics; Lactic acid bacteria as live vaccines; Factors affecting delignification; Bioconversion of substrates, anti-nutritional factors present in feeds; Microbial detoxification of aflatoxins; Single cell protein, Bioinsecticides; Biofertilizers; Recent advances in microbial biotechnology.

UNIT V

Case study on the application of microbial technology used in bioremediation of urban polluted river; Microbial EOR technology; Culture free detection and identification of unknown RNA viruses; Case study on the genetic epidemiology with MiSeq.

SUGGESTED READINGS:

1. Barredo, J. L. (Ed.). (2005). Microbial processes and products(Vol. 18). Humana Press.
2. Glazer, A. N., & Nikaido, H. (2007). Microbial biotechnology: fundamentals of applied microbiology. Cambridge University Press.

3. Perlman, D. (Ed.). (2009). Microbial Technology: Microbial Processes. Elsevier.
4. Braun,V., & Gotz, F.(2002). Microbial Fundamentals of Biotechnology. Wiley-VCH
5. Saunders, V. A. (2012). Microbial genetics applied to biotechnology: principles and techniques of gene transfer and manipulation. Springer Science & Business Media.
6. Harzevili, F. D., & Chen, H. (Eds.). (2014). Microbial Biotechnology: Progress and Trends. CRC Press.
7. Shukla, P. (Ed.). (2017). Microbial Biotechnology: An Interdisciplinary Approach. CRC Press.

23RBTE302 Bioprocess Modelling and Simulation 4H- 4C

Instruction Hours / Week: L: 4 T: 0 P: 0 Marks External: 100 Total: 100
End Semester Exam: 3 Hours

UNIT I

Modelling Principles, model development from first principles. Modelling approaches for Biological systems – structured and unstructured systems; Compartment models; Deterministic and stochastic approaches for modelling structured systems.

UNIT II

External mass transfer, Internal diffusion and reaction within biocatalysts, derivation of finite model for diffusion-reaction systems, dimensionless parameters from diffusion-reaction models, the effectiveness factor concept, case studies; oxygen diffusion effects in a biofilm, biofilm nitrification

UNIT III

Bioreactor modelling: Ideal and non-ideal bioreactors; Stirred tank models; characterization of mass and energy transfer distributions in stirred tanks, Tower Reactor Model; Flow modelling, bubble column flow models, mass transfer modelling, structured models for mass transfer in tower reactors, process models in tower reactors, airlift models,

UNIT IV

Study of linear systems, linearization of non-linear systems; Simulation of linear models using MATLAB; Parameter estimation and sensitivity analysis; Steady state and unsteady state systems; stability analysis; Case study of recombinant protein production.

UNIT V

Advanced modelling techniques such as fuzzy logic, neural network, hybrid systems and fuzzy logic systems; case studies.

SUGGESTED READINGS:

1. Bequette, B. W. (2098). 'Process Dynamics: Modelling, Analysis and Simulation'. Prentice-Hall.
2. Elnashaie, S. S., & Garhyan, P. (2003). Conservation equations and modelling of chemical and biochemical processes. CRC Press.
3. Dunn, I. J. (2005). 'Biological Reaction Engineering: Dynamic Modelling Fundamentals with Simulation'. Wiley-VCH.

23RBTE303 Molecular Modelling and Drug Designing 4H- 4C

Instruction Hours / Week: L: 4 T: 0 P: 0 Marks External: 100 Total: 100
End Semester Exam: 3 Hours

UNIT-1

Molecular mechanics, Energy minimization, intra molecular interactions, Physicochemical parameters in drug design Ionization constants, chelation, solubility and partition Co- efficient. Over view of Molecular Descriptors.

UNIT-II

Introduction to molecular Simulation Techniques-Monte Carlo Methods-Metropolis Monte Carlo Algorithm, Flow calculations in Metropolis Monte Carlo Algorithm with examples- Ising Lattice, Gibbs Ensemble Monte Carlo Simulations. Molecular Dynamics Methods-different methods for the integration of Dynamical Equations, Molecular Dynamics of rigid non linear poly atomic molecules in other ensembles, Structural information from M.D.

UNIT-III

Rational basis of drug designing, criteria for synthesizing drugs, Drug designing approaches-Phamacophore based drug design- lead and target tissues, lead finding and lead optimization, action and reaction, Structure based drug design process of Structure based design, Receptor based design-drug designing using known receptor structure, design of energy inhibitors.

UNIT-IV

Overview of computer based tools for drug designing- Ludi, Ludi/CAP, Autodock, GRAMM, CAMD tools, scoring and Docking mode, QSAR principles and Methods in drug designing. Current research in drug designing- a case study.

UNIT – V

Molecular Modelling in drug design: A Case study - Antiviral and Anticancer drug discovery, Recent Advances in the molecular simulation of Drug discovery process, molecular dynamics in personalized medicines.

SUGGESTED READINGS:

1. Leach, A. R. (2001). Molecular Modelling, Principles and application. 2nd Edition. Prentice Hall.

2. Krogsgaard, L. (2002). Text Book of Drug Design and Discovery. Taylor & Francis, London.
3. Walsh, G. (2003). Biopharmaceuticals-Biochemistry and Biotechnology. Wiley.
4. Scolnick, J. (2001). Drug Discovery and Design. Academic Press, London.
5. Cohen, N. C. (2016). Guidebook on Molecular Modelling in Drug Design. 1st Edition. Academic Press, San Diego.

23RBTE304 **Nanobiotechnology** **4H- 4C**

Instruction Hours / Week: L: 4 T: 0 P: 0 **Marks External: 100** **Total: 100**
End Semester Exam: 3 Hours

UNIT I

Introduction to Nanoscience and Nanotechnology; Milestones in Nanotechnology; Overview of Nano-biotechnology and Nanoscale processes; Challenges and opportunities with biology on nanoscale; Nano-biotechnology systems.

UNIT II

Types of Nanomaterials (Quantum dots, Nanoparticles, Nanocrystals, Dendrimers, Buckyballs, Nanotubes); Physicochemical properties of nanomaterials, Gas, liquid, and solid – phase synthesis of nanomaterials; Lithography techniques (Photolithography, Dip-pen and Electron beam lithography); Thin film deposition;Electrospinning. Biosynthesis of nanomaterials; Biologically relevant molecular nanostructures, protein and DNA based nanostructures.

UNIT III

Characterization techniques for biological molecular nanostructures, Optical Properties: Absorption, Fluorescence, and Resonance; Methods for the measurement of nanomaterials; Microscopy measurements: SEM, TEM, AFM and STM. Confocal and TIRF imaging, Dynamic light scattering; Imaging of bio-nanostructures, OCT, MRI, X-ray, CT, PET, Confocal and SPECT.

UNIT IV

Bio-nanomaterials, Biomolecules for designing nano-structures, Properties of DNA and motor proteins; Lessons from nature on making nano devices; Reactive groups on biomolecules (DNA & Proteins); Surface modification and conjugation tonanomaterials. Fabrication and application of DNA nanowires; Nanofluidics to solve biological problems.

UNIT V

Nano drugs, Structure and preparation, Lipid based nanoparticles, Solid Lipid Nanoparticles, Properties of nanocarriers; drug delivery systems used in nanomedicine; drug delivery, gene delivery, protein delivery and therapy, biocompatibility and cytotoxicity of nanoparticles, Applications of nano-structures in drug discovery, delivery and controlled release.

SUGGESTED READINGS:

1. Niemeyer, C. M., & Mirkin, C. A. (Eds.). (2004). Nanobiotechnology: concepts, applications and perspectives (Vol. 1). John Wiley & Sons.
2. Shoseyov, O., & Levy, I. (Eds.). (2008). Nanobiotechnology: bioinspired devices and materials of the future. Springer Science & Business Media.
3. Rosenthal, S. J., & Wright, D. W. (Eds.). (2005). NanoBiotechnology protocols (Vol. 1). Totowa: Humana Press.
4. Singh, D. K. (2008). Fundamentals of manufacturing engineering. CRC Press.
5. Clarke, A., Eberhardt, C. N., & Eberhardt, C. (2002). Microscopy techniques for materials science. Woodhead Publishing.

23RBTE305 Environmental Biotechnology 4H- 4C

Instruction Hours / Week: L: 4 T: 0 P: 0 Marks External: 100 Total: 100
End Semester Exam: 3 Hours

UNIT I

Microbial flora of soil, Ecological adaptations, Interactions among soil microorganisms, biogeochemical role of soil microorganisms. Biodegradation, Microbiology of degradation and its mechanism, Bioaugmentation, Biosorption, Bioleaching, Bioremediation- Types of Bioremediation, Bioreactors for Bioremediation, Metabolic pathways for Biodegradation for specific organic pollutants.

UNIT II

Pollution- Sources of pollutants for Air, Water (ground water, marine), Noise, Land and its characteristics- Pollution control and management- Environmental monitoring & sampling, Physical, chemical and biological methods and analysis- Air pollution- control and treatment strategies. Modes of Biological treatment methods for wastewater- aerobic digestion, anaerobic digestion, Anoxic digestion, the activated sludge process, Design and modelling of activated sludge processes, Aerobic digestion, Design of a trickling biological filter, Design of anaerobic digester.

UNIT III

Industrial waste management- Dairy, Paper & Pulp, Textile, leather, plastic, hospital and pharmaceutical industrial waste management, e-waste- radioactive and nuclear power waste management- Solid waste management, recovery of byproducts from industrials and municipal waste.

UNIT IV

Molecular biology tools for Environmental management, rDNA technology in waste treatment, genetically modified organisms in Waste management, Genetic Sensors, Metagenomics, Bioprospecting, Nanoscience in Environmental management, Phytoremediation for heavy metal pollution, Biosensors development to monitor pollution, Role of genetically modified organisms in pollution control and remediation

UNIT V

Alternate Source of Energy, Biomass as a source of energy, Biocomposting, Vermiculture, Biofertilizers, Organic farming, Biofuels, Biomineralization, Bioethanol and Biohydrogen, Bioelectricity through microbial fuel cell, energy management and safety. Biopesticides and biofertilizers

SUGGESTED READINGS:

1. Chakrabarty K.D., Omen G.S., (2010). Biotechnology And Biodegradation, Advances In Applied Biotechnology Series (Vol.1). Gulf Publications Co. London.
2. Eddy, M. (2011). Wastewater engineering: treatment, disposal and reuse. 2nd Edition. McGraw-Hill, New York, USA.
3. Forster, C. F., & Waste, D.A.J., (2017). Environmental Biotechnology. Ellis Harwood Halsted Press.
4. Bailey, J. E. & Ollis, D. F., (2006). Biochemical Engineering Fundamentals. 2nd Ed. Mc Graw Hill, New York.
5. Scragg Alan. (2005). Environmental Biotechnology. Longman.
6. Old R.W., & Primrose, S.B., (2006). Principles of Gene Manipulation and Genomics. 7th Edition. Blackwell Science Publication. Cambridge.
7. Bruce E. Rittmann, Eric Seagren, Brian A. Wrenn & Albert J. Valocchi, Chittaranjan Ray, Lutgarde Raski. (2011). In-situ Bioremediation. 2nd Edition. Nayes Publication. U.S.A.

23RBTE306 **Pharmaceutical Biotechnology** **4H- 4C**

Instruction Hours / Week: L: 4 T: 0 P: 0 **Marks External: 100** **Total: 100**
End Semester Exam: 3 Hours

UNIT I

History of pharmaceutical industry, Drugs discovery and Development phases; Drugs and Cosmetics ACT and regulatory aspects; Definition: Generics and its advantages; Biogenerics and Biosimilars; The role of patents in the drug industry; Protein-based biopharmaceuticals; International Non-proprietary Names (INN) nomenclature system biosimilars regulation

UNIT II

Definition of Dosage forms, Classification of dosage forms (solid unit dosages – Tablets, capsules; liquids – solutions, lotions, suspension etc; semi-solid – ointments, creams, gel, suppositories, etc; Parenterals, Aerosols etc), Introduction to pharmacokinetics and pharmacodynamic principles (factors affecting the ADME process); bioavailability, bioequivalence.

UNIT III

Advanced drug delivery systems – controlled release, transdermals, liposomes and drug targeting. Approaches to the characterization of biosimilars; Problems in characterizing biologics (Types of biologic, Peptides, Non-glycosylated proteins, Glycosylated proteins, Monoclonal antibodies); Equivalence issues; Post-translational modifications; Effect of micro heterogeneity.

UNIT IV

Understanding principles of pharmacology, pharmacodynamics Study of a few classes of therapeutics like laxatives, antacids and drugs used in peptic ulcers, drugs used in coughs and colds, analgesics, contraceptives, antibiotics (folate inhibitors, protein synthesis inhibitors, DNA inhibitors), hormonal agonists and antagonists.

UNIT V

Erythropoietin, Insulin, Somatotropin, Interleukin-2, Interferon Granulocyte- macrophage CSF, Factor VIIa, Factor IX, Factor VIII, Tissue plasminogen activator, Monoclonal antibodies and engineered Mabs

SUGGESTED READINGS:

1. Thomas, G. (2011). Medicinal chemistry: an introduction. John Wiley & Sons.
2. Katzung B.G,(2012) 'Basic and Clinical Pharmacology', 12th Edition., PHI,

3. Ramabhadran, T. V. (2005). Pharmaceutical design and development: a molecular biology approach. CRC Press.
4. Barker, E. L. (2006). Goodman & Gilman's The Pharmacological Basis of Therapeutics. Pharmaceutical Research, 20(4), 564-565.
5. Niazi, S. K. (2002). Handbook of biogeneric therapeutic proteins: regulatory, manufacturing, testing, and patent issues. CRC Press.
6. Ho, R. J. (2013). Biotechnology and biopharmaceuticals: transforming proteins and genes into drugs. John Wiley & Sons.
7. Brahmankar, D. M., & Jaiswal, S. B. (2005). Biopharmaceutics and pharmacokinetics: A treatise. Vallabh prakashan.

23RBTE307 **Advanced Systems Biology** **4H- 4C**

Instruction Hours / Week: L: 4 T: 0 P: 0 **Marks External: 100** **Total: 100**
End Semester Exam: 3 Hours

UNIT I

Introduction to Systems Biology, Systems level understanding of biological systems. Basic concepts in Systems modelling, Networks and graph theory: Basic properties of Network: Degree, average degree and degree distribution. Adjacency matrix, eighted and unweighted networks, Bipartite network, Paths and distances, Random Networks: Erdos-Renyi model, Small- world effect, clustering coefficient, Scale-free networks: Power laws, Hubs, ultra-small property, degree exponent, The Barabasi-Albert Model. Degree correlations: assortativity and disassortativity.

UNIT II

Kinetic modelling of biochemical reactions, describing dynamics with ODEs, rate equations, deriving a rate equation, incorporating regulation of enzyme activity by effectors, E-cell platform and erythrocyte modelling.

UNIT III

Introduction to Flux balance analysis, Construction of stoichiometric matrices, Constraint based models. Network basics, examples of mathematical reconstruction of transcriptional networks and signal transduction networks.

UNIT IV

Network motifs, Feed forward loop network motif. Gene circuits, robustness of models, Chemotaxis model, Integration of data from multiple sources: Building genome scale models.

UNIT V

Tools and databases for modelling: Pathway databases KEGG, EMP, Metacyc, Enzyme kinetics database BRENDA, Gene expression databases, Biomodels database, Basics of Systems Biology Markup Language (SBML), SBML editors.

SUGGESTED READINGS:

1. Klipp, E., Liebermeister, W., Wierling, C., Kowald, A., & Herwig, R. (2016). Systems biology: a textbook. John Wiley & Sons.

2. Alon, U. (2006). An introduction to systems biology: design principles of biological circuits. Chapman and Hall/CRC.
3. Klipp, E., Herwig, R., Kowald, A., Wierling, C., & Lehrach, H. (2008). Systems biology in practice: concepts, implementation and application. John Wiley & Sons.
4. Kitano, H. (Ed.). (2001). Foundations of systems biology (pp. 1-36). Cambridge: MIT press.
5. Alberghina, L., & Westerhoff, H. V. (Eds.). (2007). Systems biology: definitions and perspectives (Vol. 13). Springer Science & Business Media.

23RBTE308 **Advances in Cancer Biology** **4H- 4C**

Instruction Hours / Week: L: 4 T: 0 P: 0 **Marks External: 100** **Total: 100**
End Semester Exam: 3 Hours

UNIT I

Epidemiology of cancer: environmental factors: tobacco, alcohol, diet, occupational exposure, hormones; Development and causes of cancer: Types of cancer, Development of cancer, Causes of cancer, properties of cancer cells, Transformation of cells in culture; Genetic basis of cancer: Oncogenes and tumor suppressor genes, apoptosis, multiple mutations in cancer - metastasis and angiogenesis, tumor viruses- Role of virus infection and human cancer.

UNIT II

Chemical Carcinogenesis, Metabolism of Carcinogenesis, Natural History of Carcinogenesis, Targets of Chemical Carcinogenesis, Principles of Physical Carcinogenesis, X-Ray radiation – Mechanism of radiation Carcinogenesis; DNA repair mechanisms – DNA repair defects and their relationship to cancer.

UNIT III

Cancer Screening (Breast, Cervical, Colorectal, Prostate, Ovarian and Lung Cancer); Common practice of diagnostic methods, cytogenetics and molecular test, routine diagnostic test, purpose of frozen section, biopsy, endoscopy, diagnostic imaging, blood test, Proteomics and genomic approach, microarray, Discovery of metabolic biomarker; sample analysis, metabolic imaging strategies (CT, MRI, PET & SPECT); bioinformatics for metabolomics data.

UNIT IV

Different forms of therapy - Chemotherapy, Hormone therapy, Radiation Therapy, Immunotherapy, Endocrine therapy, Vaccines and immune stimulation, Gene therapy: molecular targeted therapies and anti-angiogenic therapies; Detection of Cancers; Prediction of aggressiveness of Cancer; Advances in Cancer detection.

UNIT V

Tomotherapy, robotic surgery, brachytherapy, hyperthermia, alternative treatments for cancer use of herbals and nonconventional therapies, development and synthesis of new drugs and their effects; photodynamic therapy; anti-angiogenic therapy, radio-immunotherapy, cancer stem cell therapy, stem cell transplant autologous, allogeneic, syngeneic transplant, cryotherapy, laser therapy.

SUGGESTED READNGS:

1. Tannock, I. F. (2013). The basic science of oncology. 2nd edition. McGraw-Hill.
2. Knowles Margaret & Selby Peter. (2005). An Introduction To Cellular and Molecular Biology of Cancer. 4th Edition. Oxford University Press.
3. Vincent T. Devita, Theodore S. Lawrence, Steven A. Rosenberg. (2008). Cancer: Principles & Practice of Oncology. 8th Edition. Lippincott Williams and Wilkins.
4. King R.J.B.,. (2006). Cancer Biology. 3rd Edition. Pearson Prentice Hall.
5. Bunz, F. (2008). Principles of cancer genetics (Vol. 1). New York, NY, USA: Springer.
6. Dimmock, N. J., Easton, A. J., & Leppard, K. N. (2016). Introduction to modern virology. John Wiley & Sons.
7. Edmund C Lattime, Stanton L Gerson. (2013). Gene Therapy of Cancer. Academic Press. Elsevier.

23RBTE309 **Advanced Drug Delivery Systems** **4H- 4C**

Instruction Hours / Week: L: 4 T: 0 P: 0 **Marks External: 100** **Total: 100**
End Semester Exam: 3 Hours

UNIT I

Modes of drug delivery – Absorption Distribution Metabolism Excretion characteristics of Drugs – Kinetics of Drug delivery - controlled drug delivery - site specific drugs - barriers for drug targeting - passive and active targeting Strategies for site specific - time and rate controlled delivery of drugs - antibody based and metabolism-based drug delivery systems.

UNIT II

Classification of Targetted Drug Delivery systems - Nanoparticles surface modification – bioconjugation – PEGylation – antibodies - cell-specific targeting and controlled drug release - Multi-Functional Gold Nanoparticles for Drug Delivery - Virus Based-nanoparticles for targeted Drug Delivery systems.

UNIT III

Polymers - Classification - Polymer Micelles as Drug Carriers- Polymers nanotubes- Magnetic Nanoparticles as Drug Carriers- Dendrimers - Synthesis – Tectodendrimers - Nanoscale containers – Nanoscafold systems – Gene transfection – Carbon nanotubes in diagnosis and therapy - Liposomes for pharmaceutical and cosmetic applications - Liposomal Drug Carriers in Cancer Therapy - lipid-DNA complexes – liposomal peptide and protein drug delivery Liposomal anticancer and antifungal agents.

UNIT IV

Targeted delivery through enhanced permeability and retention – Cancer markers Folate receptors - Targeting through angiogenesis - Targeting to specific organs or tumor types - Tumor-specific targeting – Combination therapy – Neutron Capture therapy - Targeting tumor vasculature for Imaging - Delivery of specific anticancer agents: Paclitaxel, Doxorubicin,5- Fluorouracil.

UNIT V

Vascular Zip Codes and Nanoparticle Targeting – Theragnostic Metal Nanoshells Photothermally-modulated Drug Delivery Using Nanoshell-Hydrogel Composites Nanoporous Microsystems for Islet Cell Replacement - Molecularly-derived Therapeutics - Transdermal Drug Delivery using Low-Frequency Sonophoresis Nanoporous Implants for Controlled Drug Delivery- Functionalized Cyclodextrin nanoparticles.

SUGGESTED READINGS:

1. Vladimir,P.Torchilin. (2006). Nanoparticulates as drug carriers. Imperial College Press.
2. Deepak Thassu., Michel Deleers., Yashwant Vishnupa. (2007). Nanoparticulate drug delivery systems. CRC Press.

23RBTE310 **Cell Culture Techniques** **4H- 4C**

Instruction Hours / Week: L: 4 T: 0 P: 0 **Marks External: 100** **Total: 100**
End Semester Exam: 3 Hours

UNIT I

Design of typical plant tissue culture laboratory and its management. Sterilization methods and principles; Plant tissue culture (PTC): Media composition, phytohormones and their selective usage, cellular totipotency. Callus & suspension cultures. Plant propagation: Regeneration through meristem and callus cultures; Somatic embryogenesis; Artificial Seeds and Automation of Somatic Embryo Production. Embryo culture; Haploid plant production; Protoplast culture; Somatic hybridization; Induction & utilization of somatic variants; Cryopreservation: Storage of germplasm.

UNIT II

Principles and the technology, pharmaceutical, pigments, other natural products and beverage production; Kinetics, scale up and Characterization: optimization of physiochemical parameters. Plant secondary metabolites manipulation of different pathways (Metabolic engineering), genetic stability of production. Large scale production of secondary metabolites: Different types of reactors and their design; Biotransformation: Principle and applications; Commercialization of tissue culture technology: Concept of commercialization.

UNIT III

Media and reagents: Types, Ingredients, Physiochemical properties; Serum and its importance; Sterilization of different materials used in animal cell culture; Aseptic concepts; Maintenance of sterility; Selection, isolation and preparation of tissue (mouse and chick embryo isolation); isolation of cells by tissue disaggregation; enzymatic & mechanical methods. Viability tests and Quantitation; Sub culture; Cell lines- Characterization, maintenance and preservation, Organotypic culture; Common cell culture contaminants.

UNIT IV

Isolation of pure-colonies. Bacterial titre estimation. Growth kinetics. Culture characterization. Auxotroph culture isolation. Biochemical characterization. Antibiotic sensitivity. Bacterial recombination, Replica plating technique, Preservation methods. Screening and isolation of microorganisms, Metabolic screening, Enrichment and specific screening for the desired product. Strain improvement for the selected organism: strategies of strain improvement for primary, secondary metabolites with relevant examples. Use of UV/Chemicals, recombinant DNA technology, protoplast fusion techniques for strain improvement of primary and secondary metabolites. Selection of improved Strain/Cell line; Biology of cultured cells

UNIT V

Stem cells; Types, identification, culture and applications. Scale up studies. Concepts of tissue engineering and case studies.

SUGGESTED READINGS:

1. Bhojwani, S.S. (2016). Plant Tissue Culture: Theory and Practice. Elsevier.
2. Chawla,H.S. (2002). Introduction to Plant Biotechnology. 2nd Edition. Science Publishers Inc.
3. Roberta, H.Smith. (2013). Plant Tissue Culture. Academic Press.
4. Freshney, I. (2015). Culture of Animal Cells. 7th Edition. Wiley and sons.
5. John, R.W. (2000). 'Animal Cell Culture: A Practical Approach', 5th edition. Oxford University Press.
6. Ranga, M.M. (2007). 'Animal Biotechnology', 3rd Edition. Agrobios, India.
7. Stanbury, P.F., and Whitaker. (2016). A Principles of Fermentation Technology. Butterworth Heinmann.
8. Lansing M. Prescott. (2011). Microbiology. McGraw Hill Higher Education.