

**FACULTY OF ENGINEERING**  
**DEGREE OF DOCTOR OF PHILOSOPHY**  
**IN**  
**BIOTECHNOLOGY**

**DEPARTMENT OF BIOTECHNOLOGY**

**(REGULAR PROGRAMME)**

**CURRICULUM & SYLLABI**  
**(2021 -2022)**



**KARPAGAM ACADEMY OF HIGHER EDUCATION**  
**Deemed to be University**  
(Established Under Section 3 of UGC Act 1956)  
COIMBATORE 641 021 INDIA



**KARPAGAM ACADEMY OF HIGHER EDUCATION**

*(Deemed to be University)*  
*Established under Section 3 of UGC Act 1956)*  
Eachanari, Coimbatore-641 021. INDIA

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**FACULTY OF ENGINEERING**  
**DEGREE OF DOCTOR OF PHILOSOPHY IN BIOTECHNOLOGY (Ph.D)**  
**REGULAR PROGRAMME**

**REGULATIONS**  
**(2021)**

**CHOICE BASED CREDIT SYSTEM**

Phone : 0422- 6471113 – 5; Fax No : 0422 – 2980022, 2980023  
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Web: [www.kahedu.edu.in](http://www.kahedu.edu.in)



## **KARPAGAM ACADEMY OF HIGHER EDUCATION**

Deemed to be University

*(Established Under Section 3 of UGC Act 1956)*

Eachanari Post Coimbatore -641021, INDIA

### **FACULTY OF ENGINEERING DOCTOR OF PHILOSOPHY (Ph.D.)**

#### **REGULATIONS 2021**

**These regulations are effective from the academic year 2021-2022 and applicable to the candidates admitted to Ph.D. during 2021-2022 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**

**(2021-2022)**

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

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

**(2021-2022)**

SUB.CODE	TITLE OF THE COURSE	CREDITS	EXAM HRS	MARKS	PAGE NO
<b>PAPER - I (COMPULSORY)</b>					
21RBTE101	Research Methodology and Pedagogy	4	3	100	4
<b>PAPER - II ( COMPULSORY)</b>					
21RBTE201	Research and Publication Ethics	4	3	100	6
<b>PAPER - III (ANY ONE)</b>					
21RBTE301	Advances in Microbial Technology	4	3	100	8
21RBTE302	Bioprocess Modelling and Simulation	4	3	100	10
21RBTE303	Molecular Modelling and Drug Designing	4	3	100	12
21RBTE304	Nanobiotechnology	4	3	100	14
21RBTE305	Environmental Biotechnology	4	3	100	16
21RBTE306	Pharmaceutical Biotechnology	4	3	100	18
21RBTE307	Advanced Systems Biology	4	3	100	20
21RBTE308	Advances in Cancer Biology	4	3	100	22
21RBTE309	Advanced Drug Delivery Systems	4	3	100	24
21RBTE310	Cell Culture Techniques	4	3	100	26

**21RBTE101****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 – 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. 2<sup>nd</sup> Edition. Pearson Education.
7. Thietart, R. A. (2001). Doing management research: a comprehensive guide. Sage.

21RBTE201

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.

**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.

**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 probiotics and applications of new tools of biotechnology for quality feed/food production; 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.

**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. (2008). '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.

**UNIT-1**

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-II**

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-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. 2<sup>nd</sup> 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. 1<sup>st</sup> Edition. Academic Press, San Diego.

**UNIT I**

Introduction to Nanoscience and Nanotechnology; Milestones in Nanotechnology; Overview of Nanobiotechnology and Nanoscale processes; Physicochemical properties of materials in Nanoscales.

**UNIT II**

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

**UNIT III**

Optical Properties: Absorption, Fluorescence, and Resonance; Methods for the measurement of nanomaterials; Microscopy measurements: SEM, TEM, AFM and STM. Confocal and TIRF imaging.

**UNIT IV**

Properties of DNA and motor proteins; Lessons from nature on making nanodevices; Reactive groups on biomolecules (DNA & Proteins); Surface modification and conjugation to nanomaterials. Fabrication and application of DNA nanowires; Nanofluidics to solve biological problems.

**UNIT V**

Properties of nanocarriers; drug delivery systems used in nanomedicine; Enhanced Permeability and Retention effect; Blood-brain barrier; Active and passive targeting of diseased cells; Health and environmental impacts of nanotechnology.

**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.

**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, hospital and pharmaceutical industrial waste management, e-waste- radioactive and nuclear power waste management- Solid waste management.

**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.

**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.

### **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. 2<sup>nd</sup> 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. 2<sup>nd</sup> Ed. McGraw Hill, New York.
5. Scragg Alan. (2005). Environmental Biotechnology. Longman.
6. Old R.W., & Primrose, S.B., (2006). Principles of Gene Manipulation and Genomics. 7<sup>th</sup> 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. 2<sup>nd</sup> Edition. Naves Publication. U.S.A.

**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', 12<sup>th</sup> 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.

**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, weighted 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.

**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 READINGS:**

1. Tannock, I. F. (2013). The basic science of oncology. 2<sup>nd</sup> edition. McGraw-Hill.
2. Knowles Margaret & Selby Peter. (2005). An Introduction To Cellular and Molecular Biology of Cancer. 4<sup>th</sup> Edition. Oxford University Press.
3. Vincent T. Devita, Theodore S. Lawrence, Steven A. Rosenberg. (2008). Cancer: Principles & Practice of Oncology. 8<sup>th</sup> Edition. Lippincott Williams and Wilkins.
4. King R.J.B.,. (2006). Cancer Biology. 3<sup>rd</sup> 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.

**21RBTE309****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 Targeted 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 – Nanoscaffold 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.

**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. 2<sup>nd</sup> Edition. Science Publishers Inc.
3. Roberta, H. Smith. (2013). Plant Tissue Culture. Academic Press.
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