VIJAYANAGARA SRI KRISHNADEVARAYA UNIVERSITY

JNANASAGARA CAMPUS, BALLARI-583105

Department of Studies in

BIOTECHNOLOGY

SYLLABUS

Master of Science
(II Semester)

With effect from
2021-22

VIJAYANAGARA SRI KRISHNADEVARAYA UNIVERSITY

Department of Biotechnology

Jnana Sagara, Ballari - 583105

Distribution of Courses/Papers in Postgraduate Programme I to IV Semester as per Choice Based Credit System (CBCS) Proposed for PG Programs

III – SEMESTER

With Practical

Semester	Category	Subject code	Title of the Paper	Marks			Teaching hours/week			Credit	Duration of exams (Hrs)
				IA	SEE	Total	L	T	P		
THIRD	DSC9	21BTH3C9L	Biostatistics and Bioinformatics	30	70	100	4	-	-	4	3
	DSC10	21BTH3C10L	Medical Biotechnology and Diagnostics	30	70	100	4	-	-	4	3
	DSE1	21BTH3E1AL	A: Pharmaceutical Biotechnology and drug designing	30	70	100	4	-	-	4	3
		21BTH3E1BL	B: Microbial Biotechnology								
		21BTH3E1CL	C: Biofuels and Bioenergy								
	DSE2	21BTH3E2AL	A: Agriculture Biotechnology	30	70	100	4	-	-	4	3
		21BTH3E2BL	B: Food Technology and Nutrigenomics								
		21BTH3E2CL	C: Marine Biotechnology								
	GEC1	21BTH3G1AL	A: Introduction to Biomaterials	20	30	50	2	-	-	2	1
		21BTH3G1BL	B: Gene expression and Transgenics								
		21BTH3G1CL	C: Biomedical Waste Management								
	SEC3	21BTH3S3 LP	Research Methodology	20	30	50	1	-	2	2	1
	DSC9P7	21BTH3C9P	Biostatistics and Bioinformatics lab	20	30	50	-	-	4	2	4
	DSC10P8	21BTH3C10P	Medical Biotechnology and Diagnostics lab	20	30	50	-	-	4	2	4
Total Marks for III Semester						**600**				**24**	

Dept Name: Biotechnology
Semester-III
DSC9: Biostatistics and Bioinformatics

Course Title: **Biostatistics and Bioinformatics**	Course code: **21BTH3C9L**
Total Contact Hours: (L-T-P): **4 - 0 – 0**	Course Credits: **04**
Formative Assessment Marks: **30**	Duration of ESA/Exam: **03 Hours**
Summative Assessment Marks: **70**	

Course Outcomes (CO's):

At the end of the course, students will be able to:

1. Understand the importance of various databases.
2. Understand various dimension of bioinformatics.
3. Analyze the various databases available for protein and nucleic acids.
4. Learn sequence analysis and to compare between species and individuals

DSC9: Biostatistics and Bioinformatics

Unit	Description	Hours
1	**Biostatistics:** Basics and uses of Measures of Central values (Mean, Median, Mode), Measures of Dispersion (Standard Deviation and coefficient of variation) in data analysis and presentation. Basic theoretical knowledge of Correlation and Probability - Sample Testing: Large samples (Z), small sample test: t, Chi-square, ANOVA, Comparison of means in one or two groups (student's t-test). Principles of test of significance: One-Tailed Versus Two-Tailed Tests, p-Values, Type I and Type II Errors, The Power Function, Comparison of means in three or more groups (ANOVA), F-test.	**11**
2	**Presentation of variation by figures**: data representation: Histogram, Stem-&-Leaf Plot, Line Diagram, Frequency Polygon, Frequency Curve, Pie Diagram, Bar Diagrams, Scatter Diagram, Box-&-Whisker Plot, Bubble Plot, Growth chart, Dendrogram, Nomogram, Partogram, Pedigree Chart, Cartogram. Confidence Intervals: Confidence Intervals, Confidence Intervals for a Single Population Mean, Z and t Statistics for Two Independent	**11**

	Samples. Experimental Design: Principles: Randomization, Replication, Local control, Size and shape of the plot.	
3	**Computer application in biology:** bioinformatics and its applications. Web browsing. Information networks, nucleic acid databases: Genbank, NCBI, EMBL, DDBJ; structure of Genbank entries. Primary protein databases: PIR, SWISSPROT, TrEMBL; Secondary protein databases - PROSITE, PROFILES, PRINTS, Pfam; Structural classification databases - SCOP, CATH; Literature databases - PubMed, Medline; Bibliographic databases - OMIM, PubMed.	**11**
4	**Sequence Annotation:** Principles and tools; Sequence retrieval system Entrez, SRS; Sequence submission tool - BANKIT, SEQUIN, WEBIN, SAKURA. Molecular phylogeny - Concepts of tree - rooted and unrooted trees; Molecular Clocks, Clustering and Phenetic method, Cladistic method; Steps in constructing phylogenetic analysis; Bootstrapping strategies. Molecular viewers - Rasmol, Chime and Spdb viewer	**11**
5	**Sequence alignment**: concepts in alignment, Local & Global; Pairwise & Multiple; Tools for sequence alignment - BLAST, FASTA, Clustal W; Substitution matrices; Scoring matrices - PAM & BLOSUM; Dot plot; EST Clustering and analyses, Computational methods of gene prediction.	**11**

References:

1. Introduction to Biostatistics and Research Methods by Sunder Rao and J Richards
2. Medical Statistics by David Machin, Michael J Campbell and Stephen J Walters, John Wiley and Sons.
3. Statistical Methods, S.P. Gupta
4. Fundamentals of mathematical statistics. S.C. Gupta &Kapoor
5. Statistical methods in biological and Health Science, J.S. Milton & J.O. Tsokan
6. David W Mount. 2001. Bioinformatics Sequence and Genome analysis. Cold Spring harbor laboratory
7. David W Mount. 2004. Bioinformatics: sequence and Genome Analysis (Ed:2). Cold Spring Harbor Laboratory Press, Cold Spring Harbor, New York.
8. Primrose SB. Principles of Genome Analysis, A guide mapping and sequencing DNA from different organisms. 2nd/Edn. 1998. Blackwell Science, Oxford ISBN 0-632-04983-9.
9. Rastogi, S.C., Menderatta, M. and Rastogi, P. 2004. Bioinformatics - concepts, skills and applications. CBS Publishers & Distributors, New Delhi.

10. Arthur M Lesk. 2002. Introduction to Bioinformatics. Oxford university press. New York.

Date Course Coordinator Subject Committee Chairperson

Dept Name: Biotechnology
Semester-III
DSC10: Medical Biotechnology and Diagnostics

Course Title: **Medical Biotechnology and Diagnostics**	Course code: **21BTH3C10L**
Total Contact Hours: (L-T-P): **4 - 0 – 0**	Course Credits: **04**
Formative Assessment Marks: **30**	Duration of ESA/Exam: **03 Hours**
Summative Assessment Marks: **70**	

Course Outcomes (CO's):

At the end of the course, students will be able to:

1. Apply the concepts of medical biotechnology in disease diagnosis, prevention and treatment.
2. Asses the benefit of hemopoietic stem cells in the treatment of cancer and other diseases.
3. Apply encapsulation technology and stem cells for therapeutics, Regenerative and Nanomedicine.
4. Utilize the molecular techniques for diagnosis of Biochemical, Immune, Genetic and Neurological disorders.
5. Apply gene therapies, molecular and rDNA techniques for treatment of various diseases.

DSC10: Medical Biotechnology and Diagnostics

Unit	Description	Hours
1	**Introduction scope and applications in Medial Biotechnology:** Disease: bacterial, viral, fungal and parasitic. Investigation of epidemics. Methods of culturing and assaying: bacterial, viral and parasitic. Viral vaccines: conventional: killed/attenuated; DNA; peptide; recombinant proteins. Future development and scope of vaccines.	**11**
2	**Hemopoietic Stem Cells:** Hematopoietic stem cells differentiation, trans differentiation and growth factors. Classification and manifestations of Hemopoietic stem cell disorders, aplastic Hemopoietic stem cell disorders, clinical applications of colony stems, complications of germ therapy, replacement therapy and bone marrow transplantation, immunological principles, preservation and clinical use of blood and blood components.	**11**
3	**Regenerative and nano medicine:** Encapsulation technology and therapeutics- Diabetes, Hypothyroidism, Hemophilia	**11**

	Bioartificial organs, Stem cell therapy - Embryonic and adult Stem Cells, Totipotent, Pluripotent and Multipotent Cells. Nanomedicine – Nanoparticles, Nanodevices- medical microrobotics, nanorobotics, Microbiovers, Nanomedicine.	
4	**Molecular Diagnostics:** Molecular techniques for analysis of these disorders; Biochemical disorders; Immune, Genetic and Neurological disorders; Assays for the Diagnosis of inherited diseases; Antibody based diagnosis; Monoclonal antibodies as diagnostic reagents; Production of monoclonal antibodies with potential for diagnosis	**11**
5	**Gene and molecular therapeutics:** General introduction, potential target diseases for gene therapy, gene transfer methods, and their applications, clinical studies, pharmaceutical production and regulation. Liposome and nanoparticles mediated gene delivery. Antisense technology, Clinical applications of recombinant technology; Erythropoietin; Insulin analogs and its role in diabetes; Recombinant human growth hormone.	**11**

References:

1. Daan Crommelin, Robert D Sindelar and Bernd Meibohm (2007). Pharmaceutical Biotechnology and Fundamental Applications, 2nd edition. Informa Health care USA, Inc.
2. Willam Irving, Time Boswell and Dlawar Ala'Aldeen (2006) BIOS Instant notes in Medical Microbiology. BIOS Scientific Publication.
3. Sambamurthy K and Ashutosh Kar (2006) Textbook of Pharmaceutical Biotechnology, Paperback 1st edn. New Age International.
4. Judit Pongracz and Mary Keen (2009) Medical Biotechnology, Churchill Livingstone publication.
5. Albert Sasson (2006) Medical Biotechnology, Brookings Institution Press.
6. Bernhard O Palsson and Sangeeta N Bhatia (2003) Tissue Engineering, Pearson Prentice Hall.
7. Pamela Greenwell, Michelle McCulley. (2007) Molecular Therapeutics: 21st century medicine, 1st Edition.
8. Lela Buchingham and Maribeth L Flawsm. (2007) Molecular Diagnostics: Fundamentals, Methods and Clinical Applications, 1st Edition, F A Davis Company, Philadelphia, USA.

Date Course Coordinator Subject Committee Chairperson

Dept Name: Biotechnology
Semester-III
DSE1: A. Pharmaceutical Biotechnology and drug designing

Course Title: **Pharmaceutical Biotechnology and drug designing**	Course code: **21BTH3E1AL**
Total Contact Hours: (L-T-P): **4 - 0 – 0**	Course Credits: **04**
Formative Assessment Marks: **30**	Duration of ESA/Exam: **03 Hours**
Summative Assessment Marks: **70**	

Course Outcomes (CO's):

At the end of the course, students will be able to:

1. Understand the roles of biomolecules in the treatment of diseases
2. Develop new drug and vaccine products
3. Understand role of genomic information in development and treatment of diseases

DSE1: A. Pharmaceutical Biotechnology and drug designing

Unit	Description	Hours
1	**Biotechnology in pharmaceutical perspective:** Biology in drug discovery; Traditional drug discovery vs. rational drug discovery, rational drug discovery pipeline, concept of target-based drug design and target discovery, role of plant biotechnology in edible vaccine development. Definition: Generics and its advantages; Biogenerics and Biosimilars; Why biosimilars are not (bio) generics; The advent of Biosimilars; Protein-based biopharmaceuticals; Manufacturing processes; Global market; International Non-proprietary Names (INN) nomenclature system biosimilars regulation (EU position, US pathways, Government initiatives).	**12**
2	**Biotechnology in pharmaceutical industry:** Major areas for biotechnology in the pharmaceutical industry such as antibiotics, vaccines, diagnostics, antibodies, biopharmaceuticals (insulin, interferon, GSF, CSF & therapeutic proteins etc.); Commercial aspects, priorities for future biotechnological research.	**11**
3	**Industrial enzymes in drug development:** Penicillin amidase, lipase, oxidoreductase, nitrilase, protease etc. Use of all these enzymes for enantioselective synthesis of pharmaceutically important drugs / drug intermediates, future directions.	**10**
4	**Approved follow-on proteins/Biosimilars:**	**11**

	Characteristics of high-selling peptides and proteins, Products with expired patents; Challenging originator's patents; Target products for FOB (follow-on biologicals)/ Biosimilars development peptides; Recombinant non-glycosylated proteins; Recombinant glycosylated proteins; Industries dealing with biogenerics and its market value; World scenario; Indian scenario.	
5	**Genomics in target discovery:** Concept of genome, genes and gene expression, genome sequencing and sequence comparison methods (e.g. BLAST), gene expression comparison methods (microarray). Comparative genomics and expression genomics for target discovery of communicable diseases and lifestyle disease.	**11**

References:

1. Pharmaceutical Biotechnology (2016) Helmer E, Syrawood Publishing House, ISBN: 978-1682861066.
2. Pharmaceutical Biotechnology (2014) Sreenivasulu V, Jayaveera KN and Adinarayana K, S Chand & Company, ISBN: 978-8121942478.
3. Pharmaceutical Biotechnology Fundamentals and Application (2013) Kokare C, Nirali Prakashan, Educational Publishers, ISBN: 978-8185790688.
4. Pharmaceutical Biotechnology: Concepts and Applications (2011) Walsh G, Wiley India Pvt Ltd, ISBN: 978-8126530250.
5. Pharmaceutical Biotechnology (2002) 2nd ed. Cromelin DJA and Sindelar RD, Taylor and Francis Group, ISBN: 978-3-527-65125-2.

Date Course Coordinator Subject Committee Chairperson

Dept Name: Biotechnology
Semester-III
DSE1: B. Microbial Biotechnology

Course Title: **Microbial Biotechnology**	Course code: **21BTH3E1BL**
Total Contact Hours: (L-T-P): **4 - 0 – 0**	Course Credits: **04**
Formative Assessment Marks: **30**	Duration of ESA/Exam: **03 Hours**
Summative Assessment Marks: **70**	

Course Outcomes (CO's):

At the end of the course, students will be able to:

1. Develop deeper understanding of the microbial technology and its applications.

DSE1: B. Microbial Biotechnology

Unit	Description	Hours
1	**Introduction to microbial technology:** Microbial technology in human welfare; Isolation and screening of microbes important for industry – advances in methodology and its application; Advanced genome and epigenome editing tools (e.g., engineered zinc finger proteins, TALEs/TALENs, and the CRISPR/Cas9 system as nucleases for genome editing, transcription factors for epigenome editing, and other emerging tools) for manipulation of useful microbes/strains and their applications; Strain improvement to increase yield of selected molecules, e.g., antibiotics, enzymes, biofuels.	**11**
2	**Environmental applications of microbial technology**: Environmental application of microbes; Ore leaching; Biodegradation - biomass recycle and removal; Bioremediation - toxic waste removal and soil remediation; Global Biogeochemical cycles; Environment sensing (sensor organisms/ biological sensors); International and National guidelines regarding use of genetically modified organisms in environment, food and pharmaceuticals.	**11**
3	**Pharmaceutical applications of microbial technology:** Recombinant protein and pharmaceuticals production in microbes – common bottlenecks and issues (technical/operational, commercial and ethical); Attributes required in industrial microbes (Streptomyces sp., Yeast) to be used as efficient cloning and expression hosts (biologicals production); Generating diversity and introduction of desirable properties in industrially important microbes (Streptomyces/Yeast); Microbial cell factories; Downstream processing approaches used in industrial production process (*Streptomyces sp.*, Yeast).	**11**
4	**Food applications of microbial technology:** Application of microbes and microbial processes in food and healthcare industries - food processing and food preservation, antibiotics and enzymes production, microbes in targeted delivery application – drugs and vaccines (bacterial and viral vectors); Non-recombinant ways of introducing desirable properties in Generally recognized as safe (GRAS) microbes to be used in food (e.g., Yeast) - exploiting the existing natural diversity or the artificially introduced diversity through conventional acceptable techniques (mutagenesis, protoplast fusion, breeding, genome shuffling, directed evolution etc.).	**11**

5	**Advances in microbial technology:** Microbial genomics for discovery of novel enzymes, drugs/ antibiotics; Limits of microbial genomics with respect to use in human welfare; Metagenomics and meta-transcriptomics – their potential, methods to study and applications/use (animal and plant health, environmental clean-up, global nutrient cycles & global sustainability, understanding evolution), Global metagenomics initiative - surveys/projects and outcome, metagenomic library construction and functional screening in suitable hosts – tools and techniques for discovery/identification of novel enzymes, drugs (e.g., protease, antibiotic) etc.	**11**

References:

1. Lee, Y. K. (2013). Microbial Biotechnology: Principles and Applications. Hackensack, NJ: World Scientific.
2. Moo-Young, M. (2011). Comprehensive Biotechnology. Amsterdam: Elsevier.
3. Nelson, K. E. (2015). Encyclopedia of Metagenomics. Genes, Genomes and Metagenomes: Basics, Methods, Databases and Tools. Boston, MA: Springer US.
4. The New Science of Metagenomics Revealing the Secrets of Our Microbial Planet. (2007). Washington, D.C.: National Academies Press.
5. Journals: (a) Nature, (b) Nature Biotechnology, (c) Applied microbiology and biotechnology, (d) Trends in Biotechnology, (e) Trends in Microbiology, (f) Current opinion in Microbiology, (g) Biotechnology Advances, (h) Genome Research
6. Websites: http://jgi.doe.gov/our-science/

Date Course Coordinator Subject Committee Chairperson

Dept Name: Biotechnology
Semester-III
DSE1: C. Biofuels and Bioenergy

Course Title: **Biofuels and Bioenergy**	Course code: **21BTH3E1CL**
Total Contact Hours: (L-T-P): **4- 0 - 0**	Course Credits: **04**
Formative Assessment Marks: **30**	Duration of ESA/Exam: **03 Hours**
Summative Assessment Marks: **70**	

Course Outcomes (CO's):

At the end of the course, students will be able to:

1. Identify the biofuel sources to use as an alternative energy to fossil fuel.
2. Standardize the process to convert raw material into bioethanol and biobutanol.
3. Standardize the designs and improve the biodiesel production.
4. Standardize the process of conversion to biogas.
5. Exploring different wastewater/waste materials as different biofuel sources and study various parameters to meet the national and international standards and work out economic feasibility of different energy sources.

DSE1: C. Biofuels and Bioenergy

Unit	Description	Hours
1	**Aspects of biofuels:** Types of fuels. Types of Biofuels and their production. Generations of biofuels. Conventional versus renewable energy resources. Need and availability of different alternative fuels. Comparison of Bio-energy Sources. Biofuel feedstocks and their properties. Biochemical Pathways for various of fuel production from biological sources. Biorefinery process. System biology for biofuel production.	11
2	**Bioethanol and biobutanol:** Feedstock Production: Sugar crops, Starch crops, Cellulosic crops. Bioethanol and biobutanol Production: Sugar-to-Ethanol Process, Starch-to-Ethanol Process, Cellulose-to-Ethanol Process, Distillation and Dehydration Process. Properties of Bioethanol and biobutanol. Pre-treatment processes and fermentation process. Fermenter design for bio alcohol production and types of fermenters. Technology Applications for Bioethanol: Spark Ignition Engines, Compression Ignition Engines. Fuel Cells. Standardization of Bioethanol Energy Balance of Bioethanol. Bioethanol Emissions: Greenhouse Gas Emissions, Toxic Exhaust Emissions. Sustainability of Bioethanol: Water Issues, Land Use and Biodiversity, Human Health. Economy of Bioethanol	12
3	**Biodiesel:** Conventional Diesel. Feedstock Production: Oilseed Crops, Microalgae, Animal Fats, Waste Oils. Fuel production: Oil Extraction, Oil Refining, Blending, preheating Transesterification and emulsification. Biodiesel production by using various microorganisms and algae. Biodiesel Refinery. Properties and Use of Lipid Biofuels: Properties of Pure Plant Oil (PPO),	11

	Properties of Biodiesel. Scale up of biodiesel production. Technology Applications for Lipid Biofuels: Compression Ignition Engines for Biodiesel Use, Compression Ignition Engines for PPO Use. Standardization of Lipid Biofuels: Standardization of PPO, Standardization of Biodiesel. Energy Balance of Lipid Biofuels. Emissions of Lipid Biofuels: Greenhouse Gas Emissions, Toxic Exhaust Emissions. Sustainability of Lipid Biofuels: Water Issues, Land Use and Biodiversity, Human Health. Economy of Lipid Biofuels	
4	**Biogas, biohydrogen as fuels:** Conventional gaseous fuels (Natural gas and LPG). Production methods of Biogas. Feedstock Production. Biomethane Production: Digestion Process, Digester Types, Biogas purification. Properties and Use of Biomethane. Technology Applications for Biomethane: Infrastructure Requirements for Biomethane, Vehicle Technologies for Biomethane. Standardization of Biomethane. Biomethane Emissions: Greenhouse Gas Emissions, Toxic Exhaust Emissions. Sustainability of Biomethane. Economy of Biomethane. Biohydrogen: Biohydrogen Processing, Use of Biohydrogen. Microbial fuel cell	**11**
5	**Waste materials as source of Biofuels and life cycle assessment:** Biofuels from different wastes (waste water & biomass) as sources of biofuels. Life cycle assessment of various biofuels by GREET software. Calculate the biofuel cost benefit ratios for various biofuels. Economic impact of biofuels. Status of bio fuel production in India and World.	**10**

References:

1. Yebo Li, Samir Kumar Khanal (2016). Bioenergy: Principles and Applications,1st Edition Wiley-Blackwell Publications.
2. Dominik Rutz and Rainer Janssen (2008). Biofuel Technology Handbook, WIP Renewable Energies, Germany.
3. Sterling MacMillan (2017). Bioenergy: Principles, Technology and Applications, Larsen and Keller Education
4. Nigel G Halford (2015). An Introduction to Bioenergy, Rothamsted Research, UK

Date Course Coordinator Subject Committee Chairperson

Dept Name: Biotechnology
Semester-III
DSE2: A. Agriculture Biotechnology

Course Title: **Agriculture Biotechnology**	Course code: **21BTH3E2AL**
Total Contact Hours: (L-T-P): **4- 0 - 0**	Course Credits: **04**
Formative Assessment Marks: **30**	Duration of ESA/Exam: **03 Hours**
Summative Assessment Marks: **70**	

Course Outcomes (CO's):

At the end of the course, students will be able to:

1. Understand the classical and modern approaches of plant/crop breeding
2. Understand the manipulation of plants for improved traits responsible for stress tolerance and nutrition fortification
3. Understand of preservation and protection of plants/crops

DSE2: A. Agriculture Biotechnology

Unit	Description	Hours
1	**Crop improvement**: Conventional breeding: Pedigree, heterosis and mutation breeding, limitations of conventional breeding, plant Genome – nuclear and cytoplasmic, significance of organelle genomes, genome size and sequence components, molecular markers: definition, properties, types of molecular markers: restriction based and PCR based, RFLP, AFLP, development of SCAR and SSR markers, other markers: CAPS, SNP, Marker Assisted Selection (MAS), screening and validation, trait related markers and characterization of genes involved.	**11**
2	**Plant growth regulators:** Mode of action, effects on in vitro culture and regeneration; in-vitro storage organ formation; callus culture, suspension culture- batch and continuous culture, Protoplast culture, somatic hybridization. micropropagation, Meristem culture, Shoot tip culture and production of virus free plants, somaclonal variations, in-vitro production of haploid plants – androgenesis and gynogenesis, doubled haploid production through distant hybridization, in-vitro and in-vivo pollination and fertilization, embryo culture, embryo rescue, somatic embryogenesis, artificial seeds, germplasm conservation and cryopreservation.	**11**
3	**Mapping genes on specific chromosomes**: QTL mapping, gene pyramiding, transcript mapping techniques, development of ESTs, the concept of gene synteny, the concept of map-based cloning and their use in transgenics, Antisense RNA technology- FlavrSavr Tomato, biopesticides in agriculture (botanicals and microbials), integrated pest management, Production and applications of biofertilizers (bacterial, fungal and algal); Plant secondary metabolites: Control mechanisms and manipulation of alkaloids and industrial enzymes (Shikimate and PHA pathway), importance of secondary metabolites in agriculture.	**11**

4	**Genetic engineering for increasing crop productivity**: Manipulation of photosynthesis, nitrogen fixation and nutrient uptake, Genetic engineering for biotic stress tolerance (Insects, fungi, bacteria, viruses, weeds). genetic engineering for abiotic stress tolerance (drought, flooding, salt and temperature). genetic engineering for quality improvement of protein, lipids, carbohydrates, vitamins (e.g. Golden Rice) & mineral nutrients, production of antibody in plants; Plant genetic resources, GATT & TRIPS, Patenting of biological material, patenting of transgenic organisms and genes, Plant breeders rights (PBRs) and farmers rights, Concerns about GM crops – environmental, biosafety and ethics.	**11**
5	**Plant disease and disease diagnosis:** disease epidemic, Plant pathogen interaction, the plant defense system. Phytoalexins and Immune system in plant, Innate immunity: PAMP*-triggered immunity (PTI) and effector-triggered immunity (ETI). The gene-for-gene model and the hypersensitive response (HR). Systemic acquired resistance (SAR). Disease diagnosis: Traditional methods, Immunological methods: Diffusion, Agglutination, Enzyme linked immuno sorbent assay (ELISA), Immunofluorescence techniques. Molecular techniques: Polymerase chain reaction (PCR), real time-PCR, Randomly amplified polymorphic DNA (RAPD), Restriction fragment length polymorphism, 16s rDNA.	**11**

References:

1. Introduction to plant Biotechnology (2018) 3rd ed., Chawla HS, CRC Press, ASIN: B07LH5S4P3.
2. Applied Biotechnology in Genetic Engineering, Pharmaceuticals and Agriculture (2016) Adam J, Syrawood Publishing House, ISBN: 978-1682862766.
3. Molecular Markers in Plants (2012), Henry RJ, Wiley-Blackwell. ISBN: 978-0-470-95951-0.
4. Genetic Transformation of Plants-Series: Molecular Methods of Plant Analysis (2013) Vol. 23, Jackson JF and Linskens HF, Springer, ASIN: B000PY3TJ0.
5. Plant Biotechnology – The genetic manipulation of plants (2017) 3rd ed., Slater A, Scott N and Fowler M, Oxford University Press. ISBN: 1138407674.
6. Plant Transformation Technologies (2011), 1st ed., Stewart CN and Touraev, A Wiley-Blackwell. ISBN: 9780813821955.

Date Course Coordinator Subject Committee Chairperson

Dept Name: Biotechnology
Semester-III
DSE2: B. Food Technology and Nutrigenomics

Course Title: **Food Technology and Nutrigenomics**	Course code: **21BTH3E2BL**
Total Contact Hours: (L-T-P): **4- 0 - 0**	Course Credits: **04**
Formative Assessment Marks: **30**	Duration of ESA/Exam: **03 Hours**
Summative Assessment Marks: **70**	

Course Outcomes (CO's):

At the end of the course, students will be able to:

1. Understand the concepts of nutraceutical and functional food, and their use for managing chronic diseases

DSE2: B. Food Technology and Nutrigenomics

Unit	Description	Hours
1	**Nutraceutical:** Historical perspective; definition, nature, nutraceutical compounds and their classification based on chemical/biochemical nature with suitable and relevant descriptions; scope and future prospects. Applied aspects of the nutraceutical science, relation of nutraceutical science with other sciences: medicine, human physiology, genetics, food technology, chemistry and nutrition.	**10**
2	**Functional food:** Overview; definition, classification; functional food, functional food science, food technology and its impact on functional food development; markers for development of functional foods; key issues in Indian functional food industry and nutraceutical. Relation of functional foods and nutraceutical (FFN) to foods and drugs.	**10**
3	**Antioxidants and food as remedies:** Concept of free radicals and antioxidants; antioxidants role as nutraceuticals and functional foods. Food as remedies: Nutraceuticals bridging the gap between food and drug; nutraceuticals for specific situations such as cancer, heart disease, diabetes, stress, osteoarthritis, hypertension; nutraceutical remedies for common disorders like arthritis, bronchitis, circulatory problems, hypoglycemia, liver disorders, osteoporosis, psoriasis and ulcers, etc**.**	**12**
4	**Anti-nutritional factors present in foods:** Types of inhibitors present in various foods and their inactivation. Assessment of nutritional status and recommended daily allowances. Effects of processing, storage and interactions of various environmental factors on the potentials of such foods. Marketing and regulatory issues for functional foods and nutraceuticals. Recent development and advances in the areas of nutraceutical and functional foods.	**11**
5	**Introduction to gene-diet interactions:** Nutrigenomics: Scope and Importance to Human Health and Industry. Transporter gene	**12**

	polymorphisms -interaction with effects of micronutrients in humans. Polymorphisms in genes affecting the uptake and transport of omega-6 and omega-3 polyunsaturated fatty acids: interactions with dietary lipids and chronic disease risk. Nutrigenomics approaches to unraveling physiological effects of complex foods. The intestinal microbiota - role in nutrigenomics. Modulating the risk of cardiovascular disease through nutrigenomics; Modulating the risk of diabetes through nutrigenomics; Modulating the risk of inflammatory bowel diseases through nutrigenomics	

References:

1. Prescott and Dunn (1987) Industrial Microbiology 4th Edition, CBS Publishers & Distributors. Prescott and Dunn (2002) Industrial Microbiology, Agrobios (India) Publishers.
2. Crueger W. and Crueger A. (2000) A Text of Industrial Microbiology, 2nd Edition, Panima Publishing Corp.
3. Stanbury P.F, Ehitaker H, Hall S.J (1997). Priciples of Fermentation Technology, Aditya Books (P) Ltd.
4. Adams and Moss Food Microbiology 8. Fraizer and Werthoff Food Microbiology –
5. Joshi and Pandey.Food Fermentation – Microbiology, Biochemistry & Technology, Vol. I & II.
6. Giuseppe Mazza; Functional Foods: Biochemical and Processing Aspects, Volume 1; CRC Press
7. Robert E.C. Wildman; Handbook of Nutraceuticals and Functional Foods, Second Edition; CRC Press
8. Massimo Maffei; Dietary Supplements of Plant Origin; CRC Press
9. Fereidoon Sahidi, Deepthi K. Weerasinghe; Nutraceutical Beverages, Chemistry, Nutrition and Health Effects; American Chemical Society
10. Ronald R. Watson; Vegetables, Fruits, and Herbs in Health Promotion; CRC Press
11. Fruit and Cereal Bioactives: Sources, Chemistry and Applications; ÖzlemTokusoglu; Clifford Hall III; CRC Press
12. Susan Sungsoo Cho, Mark L. Dreher; Marcel; Dekker Handbook of Dietary Fibre
13. Journal Nutrients 2012, 4, 1898-1944; Molecular Nutrition Research—The Modern Way Of Performing Nutritional Science.
14. Journal Nutrients 2013, 5, 32-57; Nutrigenetics and Metabolic Disease: Current Status and Implications for Personalized Nutrition.
15. J Nutrigenetics Nutrigenomics 2011;4:69–89; Nutrigenetics and Nutrigenomics: Viewpoints on the Current Status and Applications in Nutrition Research and Practice.
16. J Am Diet Assoc. 2006;106:569-576; Nutrigenomics: From Molecular Nutrition to Prevention of Disease.
17. The Journal of Nutrition; Nutritional "Omics" Technologies for Elucidating the Role(s) of Bioactive Food Components in Colon Cancer Prevention.
18. Nutrition 25 (2009) 1085–1093; Proteomics at the center of nutrigenomics: Comprehensive molecular understanding of dietary health effects.

Date Course Coordinator Subject Committee Chairperson

Dept Name: Biotechnology
Semester-III
DSE2: C. Marine Biotechnology

Course Title: **Marine Biotechnology**	Course code: **21BTH3E2CL**
Total Contact Hours: (L-T-P): **4- 0 - 0**	Course Credits: **04**
Formative Assessment Marks: **30**	Duration of ESA/Exam: **03 Hours**
Summative Assessment Marks: **70**	

Course Outcomes (CO's):

At the end of the course, students will be able to:

1. To evaluate marine environment and its physical features.
2. To understand the marine fisheries habitat of India.
3. To estimate the status and the trends of major fishery resources and their conservation.
4. Explain important features of microbial diversity with reference to different niches in Oceans.
5. Learn techniques of microbial culture, evaluation, maintenance preservation and storing for long time use.
6. Describe and discuss marine microbes in terms of physiological competence and biogeochemical role.
7. Analyze microbial eco system function in pelagic and benthic marine habitats.
8. Validate microbial pathogenesis, host pathogens interaction, diseases diagnosis and their economic important in food industry.

DSE2: C. Marine Biotechnology

Unit	Description	Hours
1	**Marine biology and ecology:** Classification of marine environment, Types of aquatic habitats such as coral reefs, sand dunes, mangroves, sea grasses etc., Diversity and taxonomy of marine organisms (Bacteria, Phytoplankton, zooplankton, seaweeds, sea grasses, mangroves, corals etc.),Species abundance, richness and diversity indices, Biogeography, Recruitment, Growth, Mortality, Culture of microalgae and invertebrates; Habitat preferences, Adaptations in marine organisms and energy transfer, Marine biomass and productivity - primary production, photosynthetic efficiency; secondary production, productivity distribution in ocean environment, Mechanism and factors affecting primary production	**11**
2	**Biodiversity and conservation of aquatic species:** Principles, Importance; Fish genetic resources- survey and distribution; Marine living resources assessment - Principal methods of exploitation of marine living resources, Development of novel methods for optimization of marine aquaculture; Influencing Factors, Planning and management; IUCN criteria-Red List; Wildlife protection Act; International Treaties & conventions; Marine protected Areas, Sanctuaries and Biosphere reserves, Establishment of	**11**

	Marine Parks, in situ and ex situ conservation; Cryopreservation of Gametes or Gene Banking; Institutes and societies involved in conservation; Artificial Hybridization: Heterosis, Control of fish diseases by selection; selective breeding of disease resistant fish	
3	**Marine microbial ecology and diversity:** Introduction: Marine environment, Seawater, Marine sediments, Habitats for marine microorganisms; Diversity of Marine microorganisms: Archaea, Bacteria, Cyanobacteria, Algae, Fungi, Viruses, viroids and prions and actinomycetes in coastal, shallow, deep sea, hydrothermal vents, mangrove and in coral ecosystem; Marine Symbiotic Microorganisms; Ecology: Survival of indigenous organisms and fate of non-indigenous organisms in the marine environment, Predatory-prey relationship (food-web), Degradation of complex molecules, Colonization of surfaces Chemotaxis, Attachment, Symbiotic Association, Quorum sensing, Temperature dependent microbial growth, Lethal and mutagenic factors, Protection system from osmotic damage.	**11**
4	**Microbial and micro-algal technologies in aquaculture:** Bio-floc technology; Aquaponics; Zero water exchange aquaculture system; Aquamimicry; Hydroponics; Raceway system of aquaculture; Micro-algae- indoor and mass-culture methods, Biotechnological approaches for production of important microalgae. Single cell protein from *Spirulina;* vitamins, minerals and Omega-3 fatty acids from micro-algae; enrichment of micro-algae with micronutrients; cell wall polysaccharides of micro-algae; micro algae biomass for removal of heavy metals; Biofuel production from microalgae; metabolic engineering of microalgae for biofuel production.	**11**
5	**Industrial aquaculture technology:** Fish Feed Technology: Types of feed, conventional feed vs functional feeds; Principles of feed formulation and manufacturing, diets suitable for application in different aquaculture systems; feed formulation ingredients; Use of natural and synthetic carotenoids; feed additives; Role of additives; Feed processing: Gelatinization, extrusion Technology, pellet dressing with heat liable nutrients; Post-harvest Biotechnology: Fundamental aspects of freezing, methods of freezing; Delaying of spoilage; Detection of toxic substances and pathogenic microbes; biosensors for toxin detection; Natural biomaterial used for preservation of fish, Antibiotic residual analysis techniques, Microbial and enzymatic standards of different fishery products.	**11**

References:

1. Se-kwon Kim, (2015) Handbook of Marine Biotechnology, Springer,
2. Pelczar M.J. Jr., Chan E.C.S. and Kreig N.R., (2001) Microbiology, (5th Edition), Tata McGraw Hill.
3. Felix, S., (2010) Handbook of Marine and Aquaculture Biotechnology, AGROBIOS INDIA.
4. Gautam, N.C., (2007) Aquaculture Biotechnology, Shree Publishers and Distributors.
5. Lakra, W.S. (2008) Fisheries Biotechnology, Narendra Publishing House.
6. Carl E. Bond, (2006) Biology of Fishes, 2nd Edition, W.B. Saunders Company, Philadelphia.
7. Levitus, (2000) Warming the World Ocean, Science.
8. Naskar K. and Mandal R., (1999) Ecology and Biodiversity of Indian Mangroves. Daya.
9. Jeffrey S. Levinton, CD (2001). Marine Biology: Function, Biodiversity, Ecology.
10. Artikeya, K., (2005) Biodiversity: Extinction and Conservation.

Date Course Coordinator Subject Committee Chairperson

Dept Name: Biotechnology
Semester-III
GEC1: A. Introduction to Biomaterials

Course Title: **Introduction to Biomaterials**	Course code: **21BTH3G1AL**
Total Contact Hours: (L-T-P): **2- 0 - 0**	Course Credits: **02**
Formative Assessment Marks: 20	Duration of ESA/Exam: **1 Hour**
Summative Assessment Marks: 30	

Course Outcomes (CO's):

At the end of the course, students will be able to:

1. Classify biomaterials based on their properties / applications.
2. Select appropriate biomaterial(s) for desired in-vitro or in-vivo clinical application(s).

GEC1: A. Introduction to Biomaterials

Unit	Description	Hours
1	**Introduction:** Definition of biomaterials, requirements & classification of biomaterials, Comparison of properties of some common biomaterials. Effects of physiological fluid on the properties of biomaterials. Classes of materials used in medicine, Metals, Ceramics, Synthetic polymers, Composites, Hydrogels, Bioresorbable and Biodegradable materials, Natural materials, Structure and properties relationships of biological materials.	**10**
2	**Novel Biomaterials:** Hydrogels, Self-assembling peptides, Implants materials; Metallic implant materials (stainless steels, Co-based alloys, Ti based alloys), Ceramic implant materials (aluminum oxides, hydroxyapatite glass ceramics carbons), Definition of bio ceramics. Common types of bio ceramics: Aluminum oxides, Glass ceramics, Carbons. Bio resorbable and bioactive ceramics. Polymeric implant, Polymers for drug delivery, Polyolefin's, polyamides, acrylic polymers, fluorocarbon polymers, silicon rubbers, acetyls. (Classification according to thermo sets, thermoplastics and elastomers).	**11**
3	**Properties of Biomaterials:** Biocompatibility, Properties of biomaterials, Physical, Thermal, Electrical and Optical, Surface properties and adhesion of bio-materials and their application to processing, Testing and clearance of biomaterials.	**10**
4	**Biocompatibility & Toxicological screening of biomaterials:** Definition of biocompatibility, blood compatibility and tissue compatibility. Toxicity tests: acute and chronic toxicity studies (*in situ* implantation, tissue culture, haemolysis, thrombogenic potential test, systemic toxicity, intracutaneous irritation test), sensitization, carcinogenicity, mutagenicity and special tests.	**11**

References:

1. B. D. Ratner, A. S. Hoffman, F. J. Schoen and J. E. Lemons, Biomaterials Science, Second Edition: Wiley Science (2004).

2. L. Hench and J. Jones, Biomaterials, Artificial Organs and Tissue Engineering (Woodhead Publishing in Materials (2002).
3. J. Breme, R. Thul and C. J. Kirkpatrick, Metallic Biomaterial Interfaces Wiley (2008).
4. Temenoff J.S. and Mikos A.G., Biomaterials: The intersection of Biology and Materials Science, Pearson, (2009).
5. Kinam Park, Controlled Drug Delivery: Challenges and Strategies. Washington (DC): American Chemical Society (1997).

Date Course Coordinator Subject Committee Chairperson

Dept Name: Biotechnology
Semester-III
GEC1: B. Gene expression and Transgenics

Course Title: **Gene expression and Transgenics**	Course code: **21BTH3G1BL**
Total Contact Hours: (L-T-P): **2- 0 - 0**	Course Credits: **02**
Formative Assessment Marks: 20	Duration of ESA/Exam: **1 Hour**
Summative Assessment Marks: 30	

Course Outcomes (CO's):

At the end of the course, students will be able to:

1. Understand the mechanisms of gene regulation in various groups of organisms so us to plan the genetic engineering experiments.
2. Understand the regulation of gene during the various stage of development of an organism.

GEC1: B. Gene expression and Transgenics

Unit	Description	Hours
1	**Structure of DNA and its physico-chemical properties:** Prokaryotic and eukaryotic DNA replication- DNA polymerases and proteins involved in DNA synthesis and their specific roles. Structure and properties of RNA polymerases in prokaryotes and eukaryotes. General and specific transcription factors, Mechanism of transcription and post transcriptional modifications of RNAs, RNA editing.	11
2	**Prokaryotic and eukaryotic translation:** Features of genetic code, amino-acyl synthases and charging of t-RNA, prokaryotic and eukaryotic translation, regulation of translation. Synthesis of secretary and membrane proteins, import into nucleus, mitochondria, chloroplast and peroxisomes.	11
3	**Regulation of gene expression:** Prokaryotic gene expression with reference to inducible and repressible operons. Concept of eukaryotic gene regulation. Genetic basis of pattern formation in Drosophila, homeotic loci. DNA and RNA tumour viruse; oncogenes, tumour suppressor genes and their mechanism of action. Antisense RNA and RNA interference. Applications of antisense and ribozyme technologies	11
4	**Genetically Modified Organisms-use in Basic & Applied Research:** Introduction Human genome project, Sequence component of eukaryotic genome Cloning by nuclear transfer, transgenic technology, Transgenic mice, Transgenic Drosophila, Transgenic C elegans, Transgenic Zebra Fish, Transgenic Arabidopsis, Transgenic Cattle, Transgenic	11

	Chicken, Transgenic Goat, Gene-targeted Mouse models, other applications of Transgenic Animal Technology, Transgenic Plants.	

References:

1. Molecular Cloning: a laboratory manual, Sambrook J., Fritsch EF. and Maniatis T, Cold Spring harbor Laboratory Press, (2000)
2. Introduction to Practical Molecular Biology, DEabre P, John Wiley & Sons Ltd, (1998).
3. Molecular Biology Labfax, T.A. Brown (Ed.), Bios Scientific Publishers Ltd. (1991)
4. Molecular Biology of the Gene, Watson JD., Hopkins NH., Roberts JW., Steitz JA and Weiner AM (The Benjamin/Cummings Publ.Co.), (1996).
5. Molecular Cell Biology, Darnell J, Lodish H and Baltimore D, Scientific American Books, USA, (2000)
6. Molecular Biology of the Cell, Alberts B., Bray D, Lewis J., Ralf M., Roberts K. and Watson J.D., Garland Publishing Inc. (2001)
7. Gene IX, Lewin B, Oxford University Press, (2005). Human Genetics and Genomics ; Korf BR ; 3rd Ed ; Blackwell; 2007
8. Molecular Cloning; 3rd Ed; Sambrook & Russel : Cold Spring Harbour Laboratory press, NY ; 2001
9. ICRF Handbook of Genome Analysis ; Spurr NK , Young BD , Bryant SP;1998

Date Course Coordinator Subject Committee Chairperson

Dept Name: Biotechnology
Semester-III
GEC1: C. Biomedical Waste Management

Course Title: **Biomedical Waste Management**	Course code: **21BTH3G1CL**
Total Contact Hours: (L-T-P): **2- 0 - 0**	Course Credits: **02**
Formative Assessment Marks: **20**	Duration of ESA/Exam: **1 Hour**
Summative Assessment Marks: **30**	

Course Outcomes (CO's):

At the end of the course, students will be able to:

1. Understand the basics, the Scope and importance of biomedical wastes
2. Learn about types of wastes and composition.
3. Learn about Potential health hazards of biomedical wastes.
4. Learn Direct and Indirect hazards
5. Learn about different approaches and understand the principles and methods of disposal of biomedical wastes.
6. Understand the secured land fill.
7. Learn about the different technologies of treatment and management of biomedical wastes.
8. Learn Conventional treatment technologies.
9. Understand the rules, policies and guidelines of biomedical wastes.
10. Understand the WHO guidelines for biomedical wastes**.**

GEC1: C. Biomedical Waste Management

Unit	Description	Hours
1	**Introduction to biomedical waste:** Introduction, Definition, Scope and importance of biomedical waste. Categories of biomedical wastes (Human Anatomical Waste, Animal Waste, Microbiology & Biotechnology Waste, Waste sharps, Discarded Medicines and Cytotoxic drugs, Solid Waste, Liquid Waste, Incineration Ash and Chemical Waste).	**11**
2	**Health impacts biomedical waste:** Health impacts of biomedical wastes. Direct and Indirect hazards. Potential health hazards of BMW. Infectious agents in the biomedical wastes. Monitoring and controlling of cross infection (Protective devices)	**11**
3	**Handling of biomedical waste:** Biomedical waste – Handling rules, segregation, collection, transportation, disposal-color coding and type of container for disposal of biomedical wastes. Disposal technologies (sharp disposal pit, deep burial pit and secured land fill).	**11**

4	**Treatment and management of biomedical waste:** Treatment and management of biomedical wastes-on site - pre treatments, treatment-in-site and off-site (common treatment facilities).Liquid waste treatment by different technologies. Conventional treatment technologies (wet thermal and incineration)	**11**

References:

1. Sharma – Holistic approach to Hospital Waste Management published by Dept. of
2. Bhide A. D.and B.B.Sundaresan, "Solid Waste Management – Collection, Processing and disposal" Mudrashilpa Offset Printers, Nagpur, 2001.
3. GoelS. L, Hospital Management, 2009.
4. Radhakrishnan R , Biomedical Waste Management ,Neha Publishers &Distributors,2007.
5. BeheraP K, Sustainable Bio-Medical Waste Management (2 Vols.) Dominant Publishers and Distributors 1993.
6. Hosetti,B. B.Prospects and perspective of solid waste management, 2006.
7. Glynn Henry J and Gary. W. Heinke, "Environmental Science and Engineering", Pretice Hall of India, 2004.
8. Bhide A. D and B.B.Sundaresan, "Solid Waste Management – Collection, Processing and disposal" Mudrashilpa Offset Printers, Nagpur, 2001.
9. Glynn Henry J and Gary. W. Heinke, "Environmental Science and Engineering", Pretice Hall of India, 2004.

Date Course Coordinator Subject Committee Chairperson

Dept Name: Biotechnology
Semester-III
SEC3: Research Methodology

Course Title: **Research Methodology**	Course code: **21BTH3S3LP**
Total Contact Hours: (L-T-P): **1- 0 - 2**	Course Credits: **02**
Formative Assessment Marks: **20**	Duration of ESA/Exam: **1 Hour**
Summative Assessment Marks: **30**	

Course Outcomes (CO's):

At the end of the course, students will be able to:

1. Develop skill in scientific writing, data handling and processing and development of research ideas, planning / designing of research projects.
2. Apply the knowledge and data collection methods in experiments and research work

SEC3: Research Methodology

Unit	Description	Hours
1	**Introduction to Research:** Nature and importance of research- Aims, Objectives and Principles: Fundamental research vs. applied research with examples: Qualitative vs Quantitative research: Theoretical research vs. experimental research with examples: Selection of a research problem and Sources of literature – Journals, Conferences, Books. Types of sources: Literature Survey engines- Scopus, web of Science, Google Scholar, PubMed, NCBI, Scihub, etc. Science citation index: Citations, h-index, i10 index, impact factor.	**06**
2	**Methods of Data Collection:** Data Collection Methods- Framing a hypothesis, designing controlled experiments, choosing the sample-size, sampling bias, importance of independent replicates, conducting an experiment, maintaining a lab-notebook to record observations: Identifying experimental errors. Case-studies on well-designed experiments vs. poorly designed experiments. Correlations vs. Causation. Good laboratory Practices. Introduction to Chemdraw, Chemsketch and other basic softwares.	**06**

3	**Data analysis (Practical)** Data Presentation and Writing: Technical presentation, technical writing, Formatting citations; MS Excel for plotting the data (pie chart, plots, bar charts). **Analysis using software tools:** Descriptive Statistics: Mean, standard deviation, variance, plotting data and understanding error-bars. Curve Fitting: Correlation and Regression. Distributions: Normal Distribution, Gaussian distribution, skewed distributions. Inferential Statistics: Hypothesis testing and understanding p-value. Parametric tests: Student's t-test, ANOVA. Tests to analyses categorical data: Chi-square test.	**14**

References:

1. C.R. Kothari, Research Methodology: Methods and Techniques, II Ed. New Age International Publishers, (2009).
2. Shanthibhushan Mishra, Shashi Alok, Handbook of Research Methodology, I Ed, 2017, Educreation Publishers.
3. Basic Statistical Tools in Research and Data Analysis (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5037948/).
4. Introduction to Statistical methods with MATLAB (MATLAB and Simulink Training (mathworks.com)

Date Course Coordinator Subject Committee Chairperson

Dept Name: Biotechnology
Semester-III
DSC9P7: Biostatistics and Bioinformatics lab

Course Title: **Biostatistics and Bioinformatics lab**	Course code: **21BTH3C9P**
Total Contact Hours: (L-T-P): **0- 0 - 4**	Course Credits: **02**
Formative Assessment Marks: **20**	Duration of ESA/Exam: **04 Hours**
Summative Assessment Marks: **30**	

Course Outcomes (CO's):

At the end of the course, students will be able to:

1. Understand the importance of various databases.
2. Understand various dimension of bioinformatics.
3. Analyze the various databases available for protein and nucleic acids.
4. Learn sequence analysis and to compare between species and individuals

DSC9P7: Biostatistics and Bioinformatics lab

Experiment's
1. Problems on mean, median and mode
2. Problems on variance, coefficient of variance, standard deviation (SD) and standard error (SE)
3. Probability distribution: Normal, binomial and poison
4. Test of hypotheses: Students t-test, X2 distribution (Chi square), correlation coefficient and analysis of variance (ANOVA)
5. Biological databases-file formats.
6. Data retrieval using ENTREZ
7. Searching DNA databases with FASTA and BLAST
8. Searching protein sequence databases with FASTA and BLAST
9. Sequence analysis: Multiple alignment (Clustal W)
10. Motif and domain analysis
11. Phylogenetic analysis
12. Primer designing

13. Gene finding
14. Molecular visualization using Rasmol

References:

1. Bioinformatics: Sequence and Genome Analysis by David W. Mount, Cold Spring Harbor Laboratory Press
2. Biological Sequence Analysis: Probabilistic Models of Proteins and Nucleic Acids by Richard Durbin, Sean R. Eddy, Anders Krogh, Graeme Mitchison, Cambridge University Press.
3. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, Second Edition by Andreas D. Baxevanis, B. F. Francis Ouellette, Wiley-Interscience
4. Foundations to bioinformatics – Evolution, similar macromolecular components, constancy of gene number and core proteome in closely related organisms
5. Bioinformatics data – nucleic acid sequence, protein sequence, protein structure, genomic, proteomic and metabolomics information
6. Bioinformatics databases – types, design, file formats, access tools with examples
7. Bioinformatics tools and Resources – free online tools, downloadable free tools, software packages, internet.
8. Statistical Methods, S.P. Gupta
9. Fundamentals of mathematical statistics. S.C. Gupta &Kapoor

Note:

1. Minimum of EIGHT experiments must be carried out.
2. Experiments may be added as and when required with the approval of BoS.

Date Course Coordinator Subject Committee Chairperson

Dept Name: Biotechnology
Semester-III
DSC10P8: Medical Biotechnology and Diagnostics lab

Course Title: **Medical Biotechnology and Diagnostics lab**	Course code: **21BTH3C10P**
Total Contact Hours: (L-T-P): **0- 0 - 4**	Course Credits: **02**
Formative Assessment Marks: **20**	Duration of ESA/Exam: **04 Hours**
Summative Assessment Marks: **30**	

Course Outcomes (CO's):

At the end of the course, students will be able to:

1. Apply the concepts of medical biotechnology in disease diagnosis, prevention and treatment.
2. Asses the benefit of hemopoietic stem cells in the treatment of cancer and other diseases.
3. Apply encapsulation technology and stem cells for therapeutics, Regenerative and Nanomedicine

DSC10P8: Medical Biotechnology and Diagnostics lab

Experiment's
1. Bacterial culture: establishing a pure culture; identification of bacteria; staining techniques; antibiotic sensitivity of bacteria.
2. Isolation of plasmid DNA, and its digestion by restriction endonucleases and separation of restriction fragments by agarose gel electrophoresis.
3. Isolation of RNA and separation on agarose gel and Quantitative estimation of RNA.
4. Green fluorescence protein (GFP) and bacterial transformation experiments.
5. Western blot analysis of the proteins using antibodies.
6. Identification and characterization of blood
7. Encapsulation of lymphocytes/ RBCs
8. PCR in disease diagnosis, paternity determination and criminal investigations
9. Denaturation kinetics study of biomolecules using UV-VIS spectrophotometry.
10. Drug identification by spectrophotometric method
11. Determination of aspirin concentration in given sample by spectrophotometry
12. Comparative study for the synthesis, characterization and applications of nanoparticles

13. Video based demonstration for prenatal diagnosis and gene therapy methods

References:

1. Short Protocols in molecular biology (4th edition). John Wiley and Sons, INC. New York, Chichester, Weinheim, Brisbane Singapore, Toronto.
2. Freifeldes, D. (1987). Molecular Biology (2nd edition). Jones and Bartlet Publishers: Boston, Portola Valley.
3. Sambrook, J. and Russell, D. (2001). Molecular Cloning: A laboratory manual. Vol. III, CHSL Press.

Note:

1. Minimum of EIGHT experiments must be carried out.
2. Experiments may be added as and when required with the approval of BoS.

Date Course Coordinator Subject Committee Chairperson