TULSIRAMJI GAIKWAD-PATIL College of Engineering and Technology
Wardha Road, Nagpur - 441108
Accredited with NAAC A+ Grade
Approved by AICTE, New Delhi, Govt. of Maharashtra
(**An Autonomous Institution Affiliated to RTM Nagpur University**)
Department of Biotechnology

Teaching Scheme and Syllabus

of

5th Semester B.Tech Biotechnology

(From Academic Year 2023-24)

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Department of Biotechnology

Vision of Institute

To emerge as a learning Centre of Excellence in the National Ethos in domains of Science, Technology and Management.

Mission of Institute

1. To strive for rearing standard and stature of the students by practicing high standards of professional ethics, transparency and accountability.
2. To provide facilities and services to meet the challenges of Industry and Society.
3. To facilitate socially responsive research, innovation and entrepreneurship.
4. To ascertain holistic development of the students and staff members by inculcating knowledge and profession as work practices.

Vision of the Department

To produce competent Entrepreneurs, Researchers and industry ready Professionals in Biotechnology through quality education

Mission of the Department

1. To impart quality technical education and unique interdisciplinary research by merging science and technology
2. To make students aware about techniques of modern biotechnology and industrial advancements
3. To Inculcate Social and Ethical values in the students and empower them through imparting of knowledge and skills in biotechnology

Program Education Objectives (PEO)

1. Develop Biotechnology graduates as human resource with technical competencies and strong foundation of science and engineering.
2. Acquire fundamental knowledge of mathematics, Biosciences and engineering to analyze, design and implement solutions to the Biotechnological problems.
3. Understand emerging concepts and trends in Biotechnology and allied fields.
4. Apply various tools to develop innovative systems for the bioprocesses.

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Program Outcomes (PO)

1. **Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem Analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and software tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Lifelong learning:** Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

Program Specific Outcomes (PSO)

PSO-1: Ability to apply the acquired knowledge and recent techniques to come up with ideas in the domains of Bioprocess Engineering, Bioinformatics and Biopharmaceuticals.
PSO-2: Ability to utilize their proficiency and skills in solving real life problems in Diagnostics Genetic Engineering and Fermentation Technology using recent technologies.
PSO-3: Analyzing the impact of Biotechnology Engineering solutions in the societal and human context to create productive human resource for the country.

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Scheme of Instructions: Third Year B. Tech in Biotechnology

Semester V

Sr. No.	Course Category	Course Code	Course Title	L	T	P	Contact Hrs./Wk	Course Credits	EXAM SCHEME				
									CT1	CT2	CA	ESE	TOTAL
1	PCC	BBT3501	Genetic Engineering and rDNA Technology	3	-	-	3	3	15	15	10	60	100
2	PCC	BBT3502	Fluid Mechanics and Solid Handling	3	-	-	3	3	15	15	10	60	100
3	PEC	BBT3503-05	Professional Elective -I	3	-	-	3	3	15	15	10	60	100
4	PEC	BBT3506-08	Professional Elective -II	3	-	-	3	3	15	15	10	60	100
5	OEC	B$$XX01-14	Open Elective-I	3	-	-	3	3	-	-	25	25	50
6	PCC	BBT3509	Genetic Engineering and rDNA Technology Lab	-	-	2	2	1	-	-	25	25	50
7	PCC	BBT3510	Fluid Mechanics and Solid Handling lab	-	-	2	2	1	-	-	25	25	50
8	PROJECT	BBT3511	Mini Project		-	4	4	2	-	-	50	50	100
9	HSMC	BBT3512	Entrepreneurship and Startups	3	-	-	3	3	15	15	10	60	100
10	MCC	BAU3505	Heritage	1	-	-	1	Audit	-	-	-	-	
			Total	19	0	8	27	22	75	75	175	425	750

L- Lecture T-Tutorial P-Practical CT1- Class Test 1 CT2- Class Test 2 CA- Continuous Assessment

ESE- End Semester Examination (For Laboratory: End Semester Performance)

Course Category	HSMC (Hum., Soc. Sc, Mgmt.)	BSC (Basic Sc.)	ESC (Engg. Sc.)	BS (Biological Sc.)	PCC (Professional Core courses)	PEC (Professional Elective Courses)	OEC (Biological Sc.)	Project (Project /Seminar/ Industrial Training)	MCC (Mandatory Courses)
Credits	3	-	-	--	8	6	3	2	Yes
Cumulative Sum	12	18	14	16	29	6	3	3	--

Progressive Total Credits: 79+22= 101

BOS Chairman

Head
Department Of Biotechnology
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Dean Academics

Dean Academics
Tulsiramji Gaikwad-Patil College Of Engineering and Technology, Nagpur

Vice-Principal

Vice Principal
Tulsiramji Gaikwad-Patil College Of Engineering & Technology, Nagpur.

Principal 14/02/25

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Electives for Semester V B.Tech Biotechnology

Professional Elective - I: Semester-V		Professional Elective - II: Semester-V	
BBT3503	Genome Editing	BBT3506	Waste Management and up cycling
BBT3504	Machine Learning	BBT3507	Stem cell Technology
BBT3505	Gene Expressions and Transgenics	BBT3508	Rational Drug Discovery

List of Open Elective					
Sr. No.	**Course Code**	**Course Title**	**Sr. No.**	**Course Code**	**Course Title**
1	BCSXX01	Cyber Law and Ethics	9	BMEXX09	Nanotechnology and Surface Engineering
2	BCSXX02	Block chain Technology	10	BMEXX10	Automobile Engineering
3	BITXX03	Cyber Security	11	BEEXX11	Power Plant System
4	BITXX04	Artificial Intelligence	12	BEEXX12	Electrical Materials
5	BECXX05	Internet of Things	13	BAEXX13	Avionics
6	BECXX06	Embedded Systems	14	BAEXX14	Unmanned Aerial Vehicles
7	BCEXX07	Introduction to Art and Aesthetics	15	BBTXX15	Biomaterials
8	BCEXX08	Metro Systems and Engineering	16	BBTXX16	Food and Nutrition Technology

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Third Year (Semester-V) B. Tech. Biotechnology

BBT3501: Genetic Engineering and rDNA Technology

Teaching Scheme	
Lectures	03 Hrs/Week
Tutorials	00 Hrs/Week
Total Credits	03

Examination Scheme	
CT-1	15Marks
CT-2	15Marks
CA	10Marks
ESE	60 Marks
Total	100 Marks
Duration of ESE: 03Hrs	

Course Contents

Unit 1	Modification enzymes (all enzymes necessary for genetic engineering) and their use in recombinant DNA technology, DNA markers, Marker assisted Selection and its application.
Unit 2	Concept of r-DNA Technology vectors plasmids, bacteriophages, phagemids, and Yeast artificial chromosomes-DNA. Purification of recombinant protein Cutting and joining of DNA. Vectors: concept, types of vectors (plasmids, phage, virus), Essential qualities that a vector must possess· Types of vectors: pBR322, cosmids, lambda phage.
Unit 3	Construction of Genomic DNA library and its applications: Construction of C-DNA, Library: Method, problems to be addressed, advantages and disadvantages, compared to the genomic DNA library, use DNA sequencing: Sanger-Coulson dideoxynucleotide method, Maxam-Gilbert chemical cleavage, Method, multiplex DNA sequencing, automated DNA sequencing. Basic idea of oligonucleotide synthesis.
Unit 4	Basic process of recombinant DNA technology Transformation and Transfect ion – basic techniques. Selectable markers (antibiotic resistance, lacZ) and Selection process and screening.
Unit 5	Application of genetically modified organism (Agriculture application-marker assisted selection in different crops, BT Cotton, production of transgenic pharmaceutical and fermentation. Application of gene cloning Insulin, Somatostatin, production of human proteins and drugs, recombinant vaccines, animals, human gene therapy.

Text Books

T1	Biotechnology-Expanding Horizons by B.D. Singh.
T2	Recombinant DNA technology by Keya Choudhary

Reference Books

R1	Principles of Gene manipulation and genomics by S.B. Primrose & R.M. Twyman.
R2	Gene Cloning and DNA analysis- An Introduction by T.A. Brown.

Useful Links

1	https://nptel.ac.in/courses/102104052
2	https://nptel.ac.in/courses/102103013

BBT23501	Course Outcomes	CL	Class Sessions	Lab Sessions
BBT23501.1	**Associate** the role of enzymes used in recombinant DNA technology	**2**	**8**	-
BBT23501.2	**Classify** the various types of vectors in recombinant DNA technology	**4**	**9**	-
BBT23501.3	**Illustrate** the construction of Genomic DNA library and its application.	**3**	**9**	-
BBT23501.4	**Examine** the basic process of recombinant DNA technology transformation and transfection.	**3**	**9**	-
BBT23501.5	**Demonstrate** the knowledge of genetically modified organisms to produce bioproducts.	**3**	**9**	-

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BBT3502: Fluid Mechanics and Solid Handling

Teaching Scheme	
Lectures	03 Hrs/Week
Tutorials	00 Hrs/Week
Total Credits	03

Examination Scheme	
CT-1	15Marks
CT-2	15Marks
CA	10Marks
ESE	60 Marks
Total	100 Marks
Duration of ESE: 03Hrs	

Course Contents

Unit 1	Nature of fluid and fluid flow. Mechanism of non-compressible fluid flow, Rheological properties of fermentation broths, continuity equation, Bernoulli equation, Reynolds number, frictional losses in pipe line.
Unit 2	Measurement of fluid flow, Orifice Meter, Venturi Meter, Pitot Tube, Rotameter, Notches and weirs.
Unit 3	Pumps: Classification and selection of pumps, Positive displacement pump and centrifugal pump.
Unit 4	Theory of crushing, Rittinger's law, Kick's law, Bond's Law Crushing and grinding machinery; their classification, general description of jaw crusher, gyratory crusher, roll crusher, hammer mills, ball mills, open circuit and closed-circuit Systems.
Unit 5	Filtration: Types of filtration equipment, their application and operation, sand filters, filter press, leaf filters, rotary filters, filter aids. Centrifugal filtration. Mixing in Bioreactor: Fundamental of mixing and characteristics of mixing equipment, power consumption and efficiency.

Text Books

T1	Unit Operations of Chemical Engineering, by McCabe and Smith
T2	Bioreactor Studies and Computational Fluid Dynamics by H. Singh & D. W. Hutmacher

Reference Books

R1	Bioreactors: Sustainable Design and Industrial Applications in Mitigation of GHG Emissions, 1st Edition - April 7, 2020, Lakhveer Singh, Abu Yousuf, Durga Madhab Mahapatra
R2	Bioreactors: Design, Operation and Novel Applications by Carl-Fredrik Mandenius

Useful Links

1	https://onlinecourses.nptel.ac.in/noc23_me42
2	https://microbiologynote.com/bioreactor/
3	https://www.ndsu.edu/pubweb/~qifzhang/Tech_Filtration-01.pdf

BBT23502	Course Outcomes	CL	Class Sessions	Lab Sessions
BBT23502.1	**Examine** the Nature of fluid and fluid flow	**3**	**8**	-
BBT23502.2	**Apply** various techniques for measuring of fluid flow	**3**	**9**	-
BBT23502.3	**Examine** the working and classification of pumps	**3**	**9**	-
BBT23502.4	**Summarize** the theories of crushing and crushers.	**2**	**9**	-
BBT23502.5	**Outline** the processes of Filtration and mixing in bioreactor	**4**	**8**	-

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BBT3503: PE 1- Genome Editing

Teaching Scheme	
Lectures	03 Hrs/Week
Tutorials	00 Hrs/Week
Total Credits	03

Examination Scheme	
CT-1	15Marks
CT-2	15Marks
CA	10Marks
ESE	60 Marks
Total	100 Marks
Duration of ESE: 03Hrs	

Course Contents

Unit 1	**Introduction to Gene Editing Methods**: Overview of traditional methods: homologous recombination for gene knockout, Introduction to RNA interference (RNAi) system, Overview of Cre-LoxP and Flp-FRT systems.
Unit 2	**Engineered Enzyme Systems**: Zinc finger nucleases (ZFNs) and their applications, Transcription-activator like effector nucleases (TALEN) and their applications, Mega nucleases and their applications, Introduction to the clustered regularly interspaced short palindromic repeats (CRISPR)/Cas9 system.
Unit 3	**Design and Application of CRISPR/Cas9 System**- Design of single-guide RNA (sgRNA) for CRISPR/Cas9, Multiplex Automated Genomic Engineering (MAGE) technique, Applications of targeted gene mutation using CRISPR/Cas9, Gene therapy applications of CRISPR/Cas9.
Unit 4	**Advanced Applications of Gene Editing-** Creating chromosome rearrangements using gene editing methods,studying gene function with stem cells and gene editing, Applications of gene editing in transgenic animals, Endogenous gene labeling using gene editing techniques.
Unit 5	**Ethical, Safety, and Environmental Considerations:** Discussions on ethics surrounding targeted gene editing, Safety considerations and risk assessment of gene editing techniques, Environmental impacts and risks of targeted gene editing, Application of gene editing in bioremediation and biofuel production.

Text Books

T1	CRISPR Gene Editing, Methods and Protocols, Editors: Luo, Yonglun (Ed.)
T2	Genome Editing and Engineering, From TALENs, ZFNs and CRISPRs to Molecular Surgery. Edited by Krishnarao Appasani.

Reference Books

R1	Progress in Molecular Biology and Translational Science Vol 149-Genome Editing in Plants. Edited by Donald P. Weeks and Bing Yang. Academic Press.
R2	Precision Medicine, CRISPR, and Genome Engineering, Moving from Association to Biology and Therapeutics, Editors: Tsang, Stephen H. (Ed.). Springer.

Useful Links

1	https://nptel.ac.in/courses/102103074
2	https://nptel.ac.in/courses/102103017
3	https://nptel.ac.in/courses/102103093

BBT3503	Course Outcomes	CL	Class Sessions	Lab Sessions
BBT3503.1	**Describe** the principles of traditional gene knockout methods and their limitations	2	8	-
BBT3503.2	**Analyze** the mechanism of action of different engineered enzyme systems in gene editing	4	8	-
BBT3503.3	**Demonstrate** the Design single-guide RNA (sgRNA) for CRISPR/Cas9 targeting and explore its applications	3	9	-
BBT3503.4	**Apply** gene editing methods to create chromosome rearrangements and study gene function	3	9	-
BBT3503.5	**Evaluate** ethical, safety, and environmental considerations related to gene editing	4	8	-

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BBT3504: PE I- Machine Learning

Teaching Scheme	
Lectures	03 Hrs/Week
Tutorials	00 Hrs/Week
Total Credits	03

Examination Scheme	
CT-1	15Marks
CT-2	15Marks
CA	10Marks
ESE	60 Marks
Total	100 Marks
Duration of ESE: 03Hrs	

Course Contents

Unit 1	Introduction: Learning, Types of Machine Learning, Supervised Learning, The Brain and the Neuron, Design a Learning System, Perspectives and Issues in Machine Learning, Concept Learning Task, Concept Learning as Search, Finding a Maximally Specific Hypothesis, Perceptron, Linear Separability, Linear Regression.
Unit 2	Linear Models: Multi-layer Perceptron, Going Forwards, Going Backwards: Back Propagation Error, Multi-layer Perceptron in Practice, Examples of using the MLP, Overview, Deriving Back-Propagation, Radial Basis Functions and Splines, Concepts, RBF Network.
Unit 3	Tree and Probabilistic Models: Learning with Trees, Decision Trees, Constructing Decision Trees, Classification and Regression Trees, Ensemble Learning, Boosting, Bagging, Different ways to Combine Classifiers, Probability and Learning, Data into Probabilities, Basic Statistics
Unit 4	Dimensionality Reduction and Evolutionary Models: Dimensionality Reduction, Linear Discriminant Analysis, Principal Component Analysis, Factor Analysis, Independent Component Analysis, Locally Linear Embedding, Isomap, Least Squares Optimization, Evolutionary Learning, Genetic algorithms, Genetic Offspring: - Genetic Operators, Using Genetic Algorithms
Unit 5	Graphical Models: Markov Chain Monte Carlo Methods, Sampling, Proposal Distribution, Markov Chain Monte Carlo, Graphical Models, Bayesian Networks, Markov Random Fields, Hidden Markov Models, Tracking Methods.

TextBooks

T1	Deep Learning by Ian Goodfellow, Yoshua Bengio, Aaron Courville · 2016
T2	Artificial Intelligence: A Modern Approachby Stuart Russell and Peter Norvig

ReferenceBooks

R1	Machine Learning: A Probabilistic Perspective by Kevin Murphy
R2	Pattern Recognition and Machine Learning by Christopher Bishop

UsefulLinks

1	https://onlinecourses.nptel.ac.in/noc23_cs11
2	https://machinelearningmastery.com/start-here/

BBT3504	Course Outcomes	CL	Class Sessions	Lab Sessions
BBT3504.1	**Define** the concept of supervised learning and provide examples of its applications in real-world scenarios.	**2**	**8**	**-**
BBT3504.2	**Compare** and contrast the effects of boosting and bagging as ensemble learning techniques on model performance.	**4**	**8**	**-**
BBT3504.3	**List** the steps involved in constructing decision trees and explain their significance in classification.	**2**	**8**	**-**
BBT3504.4	**Determine** the components of a genetic algorithm and describe how they contribute to the optimization process.	**3**	**8**	**-**
BBT3504.5	**Analyze** the applicability of Markov Chain Monte Carlo methods in graphical model inference and tracking tasks.	**4**	**8**	**-**

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BBT3505: PE 1- Gene Expression and Transgenics

Teaching Scheme	
Lectures	03 Hrs/Week
Tutorials	00 Hrs/Week
Total Credits	03

Examination Scheme	
CT-1	15Marks
CT-2	15Marks
CA	10Marks
ESE	60 Marks
Total	100 Marks
Duration of ESE: 03Hrs	

Course Contents

Unit 1	Vector expression, Expression vector, cloning vector. Overview of recombinant protein expression vectors and promoters: Vectors with tags His, GST, MBP, GFP. Cleavable tag and non-cleavable tags. Vectors for tag free protein expressions. Over-expression of integral membrane proteins
Unit 2	Over expression in E. coli, B. subtilis, Corynebacterium, Pseudomonas fluorescents, yeasts like S. cerevisiae and Pichia pastoris, insect cell lines like Sf21, Sf9 and BTI-TN-5B1-4, Mammalian cell line like Chinese Hamster ovary (CHO) and Human embryonic kidney (HEK),
Unit 3	Plant single cell Chloroplast transformation and protein expression in chloroplasts. Cell free protein Expression-Cell free extracts from E. coli, rabbit, wheat germ, and insects. Purification of tagged and tag-free proteins. GMP and GLP requirements.
Unit 4	Use of transgenic animals. History, safety and ethics of transgenic animals. Methods for creation of transgenic animals-DNA microinjection, Embryonic stem cell-mediated gene transfer.
Unit 5	Retrovirus-mediated gene transfer. Use transgenic animals in medical research, in toxicology, in mammalian developmental genetics, in molecular biology in the pharmaceutical industry, in biotechnology, in aquaculture and in xenografting. Humanized animal models

Text Books

T1	Textbook on Cloning, Expression and Purification of Recombinant Proteins by S. K. Gupta and A. K. Sharma
T2	CRISPR Gene Editing, Methods and Protocols, Editors: Luo, Yonglun (Ed.)

Reference Books

R1	Progress in Molecular Biology and Translational Science Vol 149-Genome Editing in Plants. Edited by Donald P. Weeks and Bing Yang. Academic Press.
R2	Precision Medicine, CRISPR, and Genome Engineering, Moving from Association to Biology and Therapeutics, Editors: Tsang, Stephen H. (Ed.). Springer.

Useful Links

1	https://nptel.ac.in/courses/104108056
2	https://nptel.ac.in/courses/102104056
3	https://nptel.ac.in/courses/102103041

BBT3505	Course Outcomes	CL	Class Sessions	Lab Sessions
BBT3505.1	**Illustrate** the various vector and system used for protein expression of protein.	**2**	**8**	-
BBT3505.2	**Apply** the knowledge of Over gene expression in different host systems,	**4**	**8**	-
BBT3505.3	**Acquire** the knowledge of the transformation and protein expression in chloroplasts	**3**	**9**	-
BBT3505.4	**Demonstrate** the different gene transfer methods for creation of transgenic animals	**3**	**9**	-
BBT3505.5	**Evaluate** the different applications of transgenic animals.	**4**	**8**	-

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BBT3506: PE II - Waste Management and up cycling

Teaching Scheme	
Lectures	03 Hrs/Week
Tutorials	00 Hrs/Week
Total Credits	03

Examination Scheme	
CT-1	15Marks
CT-2	15Marks
CA	10Marks
ESE	60 Marks
Total	100 Marks
Duration of ESE: 03Hrs	

Course Contents

Unit 1	Waste management: Definition of waste and its significance, growing global concern about waste management, environmental, economic, and health impacts of improper waste disposal, Classification of Waste- Solid waste, Hazardous waste, Liquid waste, E-waste
Unit 2	Liquid waste collection, treatment and disposal systems: Segregation and mixing schemes; Pre-treatment and its role in the industrial wastewater management; Overview of wastewater treatment technologies and development of wastewater treatment schemes; Operation and maintenance of effluent treatment plants; and Case study of an industrial wastewater management system.
Unit 3	Air Pollution management and treatment: Overview of industrial emissions; Air pollution control systems and overview of air pollution control technologies; Development of schemes for the collection, treatment and discharge industrial emissions;
Unit 4	Technologies for Waste treatment technologies: waste incineration and energy from waste, pyrolysis and gasification, anaerobic digestion, composting and mechanical biological treatment of wastes, managing biomedical waste.
Unit 5	Health considerations in the context of operation of facilities, handling of materials and impact of outputs on the environment; Advances in waste recycling and recovery technologies to deliver added value products; Landfill engineering and the management of landfill leachate and the mining of old landfills

Text Books

T1	O.P. Gupta, "Elements of Solid & Hazardous Waste Management", Khanna Publishing House, New Delhi, 2019.
T2	George Tchobanoglous et.al., "Integrated Solid Waste Management", McGraw-Hill Publishers, 1993

Reference Books

R1	B.Bilitewski, G.HardHe, K.Marek, A. Weissbach, and H.Boeddicker, "Waste Management", Springer, 1994
R2	Upcycling: A New Perspective on Waste Management in a Circular Economy by R. Jayasinghe et al.

Useful Links

1	https://nptel.ac.in/courses/105107207
2	https://nptel.ac.in/courses/103107217
3	https://nptel.ac.in/courses/105107207

BBT3506	Course Outcome	CL	Class Session	Lab session
BBT3506.1	**Classify** the types of waste	**4**	**9**	-
BBT3506.2	**Acquire** the knowledge about Liquid waste collection, treatment and disposal systems	**2**	**9**	-
BBT3506.3	**Comprehend** the knowledge of the Air Pollution management and treatment	**3**	**8**	-
BBT3506.4	**Demonstrate** the different Technologies for Waste treatment technologies	**4**	**9**	-
BBT3506.5	**Apply** the Advanced waste recycling and recovery techniques	**3**	**9**	-

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BBT3507: PE II- Stem cell Technology

Teaching Scheme	
Lectures	03 Hrs/Week
Tutorials	00 Hrs/Week
Total Credits	03

Examination Scheme	
CT-1	15Marks
CT-2	15Marks
CA	10Marks
ESE	60 Marks
Total	100 Marks
Duration of ESE: 03Hrs	

Course Contents

Unit 1	Introduction to Stem Cells: Principles & Properties of Stem Cells, Types of Stem cells, Comparison of Embryonic & Adult stem cells.
Unit 2	Stem cell niche: Introduction to stem cell niches in gut epithelium, bone marrow, epidermis, testis & neural tissues.
Unit 3	Types of regeneration- Stem cells derived from amniotic fluid, extra embryonic membrane, germ cells, hematopoietic organs, neurons & kidney. Bone marrow& cord blood collection procedures, cryopreservation, & their applications. Cord blood transplantation, donor selection, HLA matching, patient selection, peripheral & bone marrow transplantation.
Unit 4	Experimental Methods- isolation & differentiation of human adult stem cells, embryonic stem cells, mouse stem cells. Stem cell techniques- FACS, GFP tagging.
Unit 5	Applications of stem cells: Stem cell applications in cancer, diabetes, heart disease, muscular dystrophy, stem cell regulations- debate, social & ethical concerns.

Text Books

T1	Stem cells by C.S Potten., Elsevier, 2006.Essentials of Stem Cell Biology by Robert Lanza., fourth edition. Elsevier 2014.
T2	Potten CS, "Stem Cells," Elsevier, 1996.

Reference Books

R1	Ariff Bongso, Eng Hin Lee, "Stem Cells: From Bench to Bedside," World Scientific, 2011.
R2	Daniel R. Marshak, "Stem cell biology," Cold Spring Harbor Laboratory Press, 2001.

Useful Links

1	https://nptel.ac.in/courses/102106068
2	https://nptel.ac.in/courses/102106035
3	https://nptel.ac.in/courses/102106083

BBT3507	Course Outcomes	CL	Class Sessions	Lab Sessions
BBT3507.1	**Interpret** the basic concepts of stem cells.	**2**	**8**	-
BBT3507.2	**Comprehend** the microenvironments or niches that support stem cell maintenance and differentiation	**4**	**8**	-
BBT3507.3	**Acquire** the knowledge of the transformation and protein expression in chloroplasts	**3**	**9**	-
BBT3507.4	**Demonstrate** the experimental Methods, isolation & differentiation of stem cells	**3**	**9**	-
BBT3507.5	**Apply** the knowledge of stem cells in treating various diseases such as cancer, diabetes,	**4**	**8**	-

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Third Year (Semester-V) B. Tech. Biotechnology

BBT3508: PE II- Rational Drug Discovery

Teaching Scheme	
Lectures	03 Hrs/Week
Tutorials	00 Hrs/Week
Total Credits	03

Examination Scheme	
CT-1	15Marks
CT-2	15Marks
CA	10Marks
ESE	60 Marks
Total	100 Marks
Duration of ESE: 03Hrs	

Course Contents

Unit 1	**Molecular Modelling in Drug Discovery:** Drug discovery process, Role of Bioinformatics in drug design, Methods of computer aided drug design, ligand design methods, drug design approaches, Target identification and validation, lead optimization and validation, Structure and ligand-based drug design
Unit 2	**Quantum Mechanics and Molecular Mechanics:** Features of molecular mechanics force fields; Bond structure and bending angles – electrostatic, van der Waals and non – bonded interactions, hydrogen bonding in molecular mechanics; Derivatives of molecular mechanics energy function
Unit 3	**Molecular Dynamics simulation methods:** Molecular Dynamics using simple models; Molecular Dynamics with continuous potentials and at constant temperature and pressure; Time – dependent properties; Solvent effects in Molecular Dynamics
Unit 4	**Molecular Docking and lead optimization:** Molecular Docking; Types of Molecular Docking, docking algorithms and programs, Structure-based methods to identify lead compounds; de novo ligand design; Applications of 3D Databases Searching and virtual Screening; Strategy for target identification and Validation, lead identification, optimization and validation. Combinatorial chemistry and library design, virtual screening, drug likeness and compound filtering, Absorption, distribution, metabolism, excretion and toxicity (ADMET) property prediction, computer-based tools for drug design
Unit 5	**Pharmacophore and QSAR:** Pharmacophore derivation, 3D pharmacophore prediction and application in drug discovery; QSARs and QSPRs, QSAR Methodology, Various Descriptors used in QSARs: Electronic; Topology; Quantum Chemical based Descriptors. Use of Genetic Algorithms, Neural Networks and Principal Components Analysis in the QSAR equations.

Text Books

T1	Computational methods in drug design Fred E. Cohen, Walter Hamilton Moos. Publisher: ESCOM Science, 1993
T2	Molecular Modelling for Beginners - Alan Hinchliffe Publisher: John Wiley & Sons Inc, 2008. ISBN: 978-0470513149

Reference Books

R1	Combinatorial Library Design and Evaluation: Principles, Software, Tools, Applications in Drug Discovery – Arup Ghose, VellarkadViswanadhan Publisher: CRC
R1	Combinatorial Library Design and Evaluation: Principles, Software, Tools, Applications in Drug Discovery – Arup Ghose, VellarkadViswanadhan Publisher: CRC

Useful Links

1	https://nptel.ac.in/courses/102106070
2	https://nptel.ac.in/courses/102108077
3	https://nptel.ac.in/courses/104105120

BBT3508	Course Outcomes	CL	Class Sessions	Lab Sessions
BBT3508.1	**Apply** the concepts of Molecular Modelling in Drug Discovery.	**3**	**9**	**-**
BBT3508.2	**Acquire** the knowledge about Quantum Mechanics and Molecular Mechanics.	**2**	**9**	**-**
BBT3508.3	Comprehend the knowledge of the Molecular Dynamics simulation methods	**3**	**9**	**-**
BBT3508.4	**Demonstrate the** Molecular Docking and lead optimization	**4**	**9**	**-**
BBT3508.5	**Apply** the knowledge about the Pharmacophore and QSAR	**2**	**9**	**-**

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Third Year (Semester-V) B. Tech. Biotechnology

BBT3509: Genetic Engineering and rDNA Technology Lab

Teaching Scheme		Examination Scheme	
Lab Hrs.	02 Hrs/Week	CA	25 Marks
Total Credits	01	ESE	25 Marks
		Total	50 Marks
		Duration of ESE: 02Hrs	

List of Experiments

1	To analyze the induction of β-Galactosidase.	CO1
2	To examine the different DNA fragments using Restriction fragment length polymorphism (RFLP).	CO1
3	To isolate and purify the plasmid DNA.	CO2
4	To perform restriction digestion of Lambda DNA using E.coRI and HindIII Enzymes.	CO2
5	To investigate Bacterial Transformation.	CO3
6	To assess the cleaved amplified polymorphism (CAPS).	CO3
7	To quantify DNA using the E260 method.	CO4
8	To evaluate DNA purification.	CO4
9	To demonstrate the PCR amplification of a specific gene.	CO5
10	To examine the different DNA fragments using Restriction fragment length polymorphism (RFLP).	CO5

Useful Links

1	https://vlab.amrita.edu/?sub=3&brch=77
2	https://www.asbmb.org/education/online-teaching/online-lab-work
3	http://biomodel.uah.es/en/lab/inicio.htm

BBT3509	Course Outcomes	CL	Class Sessions	Lab Sessions
BBT3509.1	**Associate** the role of enzymes used in recombinant DNA technology	**2**	-	**2**
BBT3509.2	**Classify** the various types of vectors in recombinant DNA technology	**4**	-	**2**
BBT3509.3	**Illustrate** the construction of Genomic DNA library and its application.	**3**	-	**2**
BBT3509.4	**Examine** the basic process of recombinant DNA technology transformation and transfection.	**3**	-	**2**
BBT3509.5	**Demonstrate** the knowledge of genetically modified organisms to produce bioproducts.	**3**	-	**2**

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Third Year (Semester-V) B. Tech. Biotechnology

BBT3510: Fluid Mechanics and Solid Handling Lab

Teaching Scheme		Examination Scheme	
Lab Hrs.	02 Hrs/Week	CA	25 Marks
Total Credits	01	ESE	25 Marks
		Total	50 Marks
		Duration of ESE: 02Hrs	

List of Experiments

1	To observe the Laminar and Turbulent flow using Reynold's apparatus.	CO1
2	Compute the coefficient of discharge of a venturimeter.	CO1
3	Calculate the coefficient of discharge of an orificemeter.	CO2
4	Verify Bernoulli's theorem through experimentation.	CO2
5	Estimate flow rate using a rotameter.	CO3
6	Determine the coefficient of discharge of a pitot tube.	CO3
7	Evaluate the friction factor in a fluid flow system.	CO4
8	Demonstrate particle crushing using the bead mill.	CO4
9	Measure average particle size in a sample.	CO5
10	Assess the efficiency of the filter through experimentation.	CO5

Useful Links

1	https://vlab.amrita.edu/?sub=3&brch=77
2	https://www.asbmb.org/education/online-teaching/online-lab-work
3	http://biomodel.uah.es/en/lab/inicio.htm

BBT3510	Course Outcomes	CL	Class Sessions	Lab Sessions
BBT3510.1	**Examine** the Nature of fluid and fluid flow	**3**	**-**	**2**
BBT3510.2	**Apply** various techniques for measuring of fluid flow	**3**	**-**	**2**
BBT3510.3	**Examine** the working and classification of pumps	**3**	**-**	**2**
BBT3510.4	**Summarize** the theories of crushing and crushers.	**2**	**-**	**2**
BBT3510.5	**Outline** the processes of Filtration and mixing in bioreactor	**4**	**-**	**2**

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Third Year (Semester-V) B. Tech. Biotechnology

BBT3512: Entrepreneurship and Startups

Teaching Scheme	
Lectures	03 Hrs/Week
Tutorials	00 Hrs/Week
Total Credits	03

Examination Scheme	
CT-1	15Marks
CT-2	15Marks
CA	10Marks
ESE	60 Marks
Total	100 Marks
Duration of ESE: 03Hrs	

Course Contents

Unit 1	**Introduction to Entrepreneurship and Start – Ups:** Definitions, Traits of an entrepreneur, Intrapreneurship, Motivation. Types of Business Structures, Similarities/differences between entrepreneurs and managers.
Unit 2	**Concept of Startup:** Definition, Types of Startups- scalable startup, small business startup, lifestyle startup, buyable startup, social startup, big business startup. Startup Ecosystem.
Unit 3	**Idea to Start-up:** Concept of Ideation and incubation, Market Analysis – Identifying the target market, Competition evaluation and Strategy Development, Marketing and accounting, Risk analysis, Technology Readiness Levels.
Unit 4	**Funding for Startups:** Introduction, angel funding, venture funding, difference between angel and venture funding, private equity fund
Unit 5	**Management:** Company's Organization Structure, Recruitment and management of talent. Financial organization and management, causes of startup failures

Text Books

T1	Entrepreneurial Developmeent by S. S. Khanka- S. Chand, 1999
T2	Entrepreneurship Development by E. Gordon, K. Natarajan, Amishi Arora · 2009

Reference Books

R1	Entrepreneurial Development. By, S.Anil Kumar. New Age International.
R2	Small-Scale Industries and Entrepreneurship. By, Dr. Vasant Desai, Himalaya Publication

Useful Links

1	https://nptel.ac.in/courses/110106164
2	https://nptel.ac.in/courses/109105098

BBT3512	Course Outcomes	CL	Class Sessions	Lab Sessions
BBT3512.1	**Describe** entrepreneur, its traits and types of business structures.	**2**	**9**	**-**
BBT3512.2	**Illustrate** the concept of start up.	**3**	**9**	**-**
BBT3512.3	**Sketch** the concept of market analysis and ideation and incubation.	**3**	**9**	**-**
BBT3512.4	**Classify** the different types of funding for start ups.	**4**	**9**	**-**
BBT3512.5	**Distinguish** the organization structure of the company's different aspects.	**4**	**8**	**-**

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Third Year (Semester-V) B. Tech. Biotechnology

BBTXX15: OE - Biomaterials

Teaching Scheme	
Lectures	03 Hrs/Week
Tutorials	00 Hrs/Week
Total Credits	03

Examination Scheme	
CT-1	15Marks
CT-2	15Marks
CA	10Marks
ESE	60 Marks
Total	100 Marks
Duration of ESE: 03Hrs	

Course Contents

Unit 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. Biological responses (extra and intra-vascular system). Surface properties of materials, physical properties of materials, mechanical properties.
Unit 2	**Metallic implant materials**: Stainless steel, Co-based alloys, Ti and Ti-based alloys. Importance of stress-corrosion cracking. Host tissue reaction with bio metal, corrosion behavior and the importance of passive films for tissue adhesion. Hard tissue replacement implant, Soft tissue replacement implants.
Unit 3	**Ceramics and glasses-bio ceramics:** Type of Ceramics and their classification, Calcinations, Annealing. Sintering, nearly inert ceramics, bio-reactive glasses and glass ceramics, Calcium phosphate ceramics. Composite implant materials: Mechanics of improvement of properties by incorporating different elements. Composite theory of fiber reinforcement (short and long fibres, fibres pull out)
Unit 4	**Surface properties and modification of surface properties**: Basic principles of engineering manufacturing, methods and applications of common manufacturing processes, milling, grinding, finishing, rolling, forging, Concept of biomimetic synthesis
Unit 5	**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).

Text Books

T1	Computational methods in drug design Fred E. Cohen, Walter Hamilton Moos. Publisher: ESCOM Science, 1993
T2	Molecular Modelling for Beginners - Alan Hinchliffe Publisher: John Wiley & Sons Inc, 2008. ISBN: 978-0470513149

Reference Books

R1	Materials Science and Engineering- Callister.
R2	Materials for Medical Engineering- Euromat 99 vol-2

Useful Links

1	https://nptel.ac.in/courses/113104009
2	https://nptel.ac.in/courses/102106057
3	https://nptel.ac.in/courses/113108071

BBTXX15.1	Course Outcomes	CL	Class Sessions	Lab Sessions
BBTXX15.1	**Demonstrate** the fundamental concepts of properties, requirements & classification of biomaterials.	**2**	**9**	**-**
BBTXX15.2	**Acquire** the knowledge about various types of Metallic implant materials.	**2**	**9**	**-**
BBTXX15.3	**Summarize** the types and classification on Ceramics and glasses-bio ceramics.	**3**	**9**	**-**
BBTXX15.4	**Demonstrate** the Surface properties and modification of surface properties.	**4**	**9**	**-**
BBTXX15.5	**Comprehend** the principles of biocompatibility, interactions between biomaterials and biological systems	**2**	**9**	**-**

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Third Year (Semester-V) B. Tech. Biotechnology

BBTXX16: OE - Food and Nutrition Technology

Teaching Scheme	
Lectures	03 Hrs/Week
Tutorials	00 Hrs/Week
Total Credits	03

Examination Scheme	
CT-1	15Marks
CT-2	15Marks
CA	10Marks
ESE	60 Marks
Total	100 Marks
Duration of ESE: 03Hrs	

Course Contents

Unit 1	**Introduction to food biotechnology**: Introduction, History and scope of food Biotechnology, development and prospects of biotechnology in animal products, ancient and traditional food processing techniques; Biochemical and metabolic pathways of biological systems used in food production.
Unit 2	**Methods in food biotechnology**: Role of biotechnology in productivity of livestock, Modern biotechnological methods and processes in animal product development, chemical and physical factors required for growing microbial cultures in nutritive substrate; Meat species identification, Quality control, Screening products for contaminants.
Unit 3	**Biotechnology methods in food processing**: Use of biotechnology in the production of food additives, use of biotechnological tools for the processing and preservation and foods of animal origin, use of biotechnology improved enzymes in food processing industry, Basic principles of the industrial use of bio-reactions for production of biomass
Unit 4	**Food safety & security**: Consumer concerns about risks and values, biotechnology & food safety, Ethical issues concerning GM foods; testing for GMOs; current guidelines for the production, release and movement of GMOs; Future and applications of food biotechnology in India.
Unit 5	**Food Preservation Technology**: Definition and importance of food preservation. Historical overview of food preservation techniques. Factors contributing to food spoilage (microbial, enzymatic, chemical, and physical). Understanding the role of microorganisms in food deterioration. Food Preservation Methods: Canning and bottling. Pasteurization. Refrigeration. Freezing. Sun drying. Air drying. Antimicrobial agents (e.g., preservatives, additives). Acidification (e.g., pickling, fermentation).

Text Books

T1	Fundamental Food Microbiology (3rd Edition) – by Bibek Ray. CRC Press: ISBN - 0-8493-1610-3
T2	Toledo, R.T. Fundamentals of Food Process Engineering, Chapman and Hall; 2000

Reference Books

R1	Shakuntala, N., & Many, O. Food: Facts and Principles, New Age International; 2001.
R2	Food, Nutrition and Diet Therapy by Krause and Mahan 1996, Publisher- W.B.Saund

Useful Links

1	https://nptel.ac.in/courses/103107088
2	https://nptel.ac.in/courses/126105013
3	https://nptel.ac.in/courses/126105027

BBTXX16	Course Outcomes	CL	Class Sessions	Lab Sessions
BBTXX16.1	**Acquire** fundamental knowledge of microbes associated with food and factors responsible for food spoilage.	**2**	**9**	**-**
BBTXX16.2	**Describe** the different methods in food biotechnology	**2**	**9**	**-**
BBTXX16.3	**Learn** about various food processing methods such as preservation, pasteurization, fermentation, and sterilization, and their impact on food products.	**2**	**9**	**-**
BBTXX16.4	**Comprehend** the principles of food security, safety, Ethical issues, testing and current guidelines for the production, release and movement of GMOs	**4**	**9**	**-**
BBTXX16.5	**Apply** the principle of food preservation techniques	**2**	**9**	**-**

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BAU3505: Heritage

Teaching Scheme	
Lectures	02 Hrs/Week
Tutorials	-
Total Credits	00

Examination Scheme	
CT-1	15Marks
CT-2	15Marks
CA	10Marks
ESE	60 Marks
Duration of ESE: 03Hrs	

Activity

Visit to museum, archaeology sites, cultural walks, tours, local traditions, food and clothing, festival and local games awareness,

Process

The course will involve study of archeological sites, monuments and buildings, museums and local traditions. Preference should be given to local sites, monuments and traditions. Students can alternatively be asked to study such sites and traditions in their home regions. An institution can also adopt an archeological site / monument / custom in its area and involve students in its preservation and promote awareness about it among people at large. Students should be asked to identify an archeological site/monument/local custom and tradition/ artifacts in a museum, to conduct research to gain information about various aspects related to them and to write project reports or to prepare short documentaries.

Each locality/region our Indian sub-continent abounds in a rich variety of food-ways, fairs and festivals, games and sports. Students should be asked to identify one of these traditions and study them in detail.

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