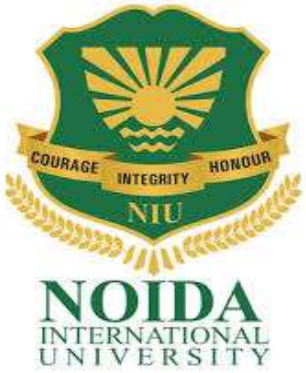
Noida International University



Evaluation Scheme & Syllabus

For

B. Tech

(Bio Technology)

On

AICTE MODEL CURRICULUM

(Effective from the Session: 2018-19)

Noida International University

FOR B. TECH-BIOTECHNOLOGY COURSE

(Effective from Academic session 2018-2019)

Introduction- B. Tech in Biotechnology is an academic programme of the duration of four years. Biotechnology engineering is an undergraduate degree programme in applied sciences that amalgamates the facts from both Biological sciences and technology. This study utilizes the biological processes which include the study of microorganisms or knowledge of antibiotics and further implement them in various industrial purpose.

In simple terms, Biotechnology is a study which involves the use of living organisms. The living organisms are used to make useful chemicals which can be utilized in industries. Biotechnological products are used in areas like agriculture, food sciences and medicine.

Program Educational Objectives (PEOs)

The Department of Biotechnology has developed and maintained a well-defined set of educational objectives and desired program outcomes. Educational objectives of the program cater to the requirements of the stakeholders such as students, parents, employers, alumni, faculty etc. The program educational objectives are as follows:

- **PEO**1: Provide graduates with a strong foundation in mathematics, science and engineering fundamentals to enable them to devise and deliver efficient solutions to challenging problems in Electronics, Communications and allied disciplines.
- **PEO**2: Impart analytic and thinking skills to develop initiatives and innovative ideas for R&D, Industry and societal requirements.
- **PEO**3: Provide sound theoretical and practical knowledge of both Biological sciences and technology, managerial and entrepreneurial skills to enable students to contribute to the well-being of society with a global outlook.
- **PEO**4: Inculcate qualities of teamwork as well as social, interpersonal and leadership skills and an ability to adapt to evolving professional environments in the domains of engineering and technology.
- **PEO**5: Motivate graduates to become good human beings and responsible citizens for the overall welfare of the society.

Programme specific outcome (PSO)

- Acquire knowledge on the fundamentals of biotechnology for sound and solid base which enables them to understand the emerging and advanced engineering concepts in life sciences.
- Acquire knowledge in domain of biotechnology enabling their applications in industry and research.
- Empower the students to acquire technological knowhow by connecting disciplinary and interdisciplinary aspects of biotechnology

Program outcomes (POs)

Engineering Graduates will be able to:

- **PO1. Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- **PO2. 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.
- **PO3. 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.
- **PO4. 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.
- **PO5. Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
- **PO6. 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.
- **PO7. 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.
- **PO8. Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- **PO9. Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- **PO10. 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.
- **PO11. 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.
- **PO12. Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Credit System-Credit requirement for award of B. Tech:

- Every semester shall offer a minimum of 12 credits and a maximum of 24 credits.

- Credits for the Project or Thesis can vary from 10 to 15.
- The total number of credits for the B. Tech Degree Course could vary from a minimum of 158 credits to a maximum of 178 credits.
- All courses of study put together would engage the students for a minimum of 26 periods or hours of study a week and a maximum of 30 periods or hours a week.

Under the Choice based credit system, which is a student or learner centric system, the courses of study in the B. Tech Degree course shall be as under:

a) Professional Core (PC) Course: A course, which should compulsorily be studied by a candidate as a core requirement is termed as a Core course.
b) Basic Sciences and Engineering Science (BS and ES) Course: A course which informs the Professional core and should compulsorily be studied.
c) Elective Course: Generally, a course which can be chosen from a pool of courses and are of two types:
(i) Professional Elective (PE) which may be very specific or specialized or advanced or supportive to the discipline or subject of study or which provides an extended scope
(ii) Open Elective (OE) which enables an exposure to some other discipline or subject or domain or nurtures the candidate 's proficiency or skill

The Weightage in terms of Credits for each of the above in the prescribed curriculum of the institution shall be as follows:

S.no.	Credit Breakups	Credits
1	Humanities and Social Sciences including Management courses	11
2	Basic Science courses	23
3	Engineering Science courses including workshop, drawing, basics of electrical/mechanical/computer etc.	20
4	Professional core courses	59
5	Professional Elective courses relevant to chosen specialization/branch	16
6	Open subjects – Electives from other technical and /or emerging subjects	12
7	Project work, seminar and internship in industry or elsewhere	17
8	Mandatory Courses	0
		*158

***Minor variation is allowed as per need of the respective disciplines**.

While calculating credits the following guidelines shall be adopted, namely: -

- 1 Hr. Lecture (L) per week 1 credit
- 1 Hr. Tutorial (T) per week 1 credit
- 1 Hr. Practical (P) per week 0.5
- 2 Hours Practical (Lab)/week 1 credit

Credit distribution in each semester (160 credits to 8 semesters)

Semester	Credits		
	Theory	Practical	Total
1st	14	6.5	20.5
2nd	13	4.5	17.5
3rd	18	4	22
4th	18	3	21
5th	17	5	22
6th	18	3	21
7th	14	7	21
8th	6	9	15
Total	**113**	**42**	**160**

Course coding system

Every course coded as follows:

BSC : Basic Science Courses

ESC : Engineering Science Course

MC : Mandatory Courses

HSMC : Humanities and Social Sciences including Management

PCC : Program core courses

PEC : Program Elective courses

OEC : Open Elective courses

B. TECH BIOTECHNOLOGY

(LIST OF PROFESSIONAL ELECTIVES & OPEN ELECTIVES SUBJECTS)

DEPARTMENTAL ELECTIVES -I
DE BT 11: Pharmaceutical Biotechnology
DE BT 12: Nano Biotechnology
DE BT 13: Biomedical Instrumentation
DE BT 14: Metabolic Engineering

DEPARTMENTAL ELECTIVES - II
DE BT 21: Biofuels and alcohol technology
DE BT 22: Descriptive Statistics & Process Control
DE BT 23: 3-D Printing
DE BT 24: Molecular modelling and drug design

DEPARTMENTAL ELECTIVES – III
DE BT 31: Animal Biotechnology
DE BT 32: Biomarker & Diagnostics
DE BT 33: Food Biotechnology
DE BT 34: Entrepreneurship in Biotechnology

DEPARTMENTAL ELECTIVES – IV
DE BT 41: Big Data Analytics
DE BT 42: Biosimilar Technology
DE BT 43: Stem Cell Technology
DE BT 44: Gene Expression & Transgenic

DEPARTMENTAL ELECTIVES – V
DE BT 51: Precision Medicine & Wellness
DE BT 52: Tissue Engineering
DE BT 53: Waste Management & Upcycling

OPEN ELECTIVES-I
1. Database Management System
2. Embedded System
3. GIS & Remote Sensing
4. Computer based Numerical Techniques

OPEN ELECTIVES-II
1. Internet of Things
2. Artificial Intelligence
3. Software Project Management System

OPEN ELECTIVES-III
1. Robotics

2. Food and Nutrition Technology
3. Cyber Security

OPEN ELECTIVES-IV

1. Bioterrorism and National Security
2. Data Sciences
3. Block chain

SEMESTER-VII											
Sl. No	**Subject Codes**	**Subject**	**Contact Hours/Week**			**Evaluation Scheme End Semester**					
			L	**T**	**P**	**CA**	**TA**	**Total Internal**	**External**	**Total**	**Credit**
1	PCC BT-701	Professional Core Course	2	0	0	20	20	40	60	100	2
2	DE BT 4X	Departmental Elective IV	3	0	0	20	20	40	60	100	3
3	DE BT 5X	Departmental Elective V	3	0	0	20	20	40	60	100	3
4	OE BT 2X	Open Elective II	3	0	0	20	20	40	60	100	3
5	PLC BT-751	Professional Core Course Lab	0	0	2	20	20	40	60	100	1
6	DLE BT-752	Departmental Elective IV Lab	0	0	2	20	20	40	60	100	1
7	PS 401	Project I	0	0	10	-	-	200	100	300	5
8		**MOOCs (Essential for Hons. Degree)**									
		Total	**11**	**0**	**14**					**1000**	**18**

SEMESTER-VIII											
Sl. No	**Subject Codes**	**Subject**	**Contact Hours/Week**			**Evaluation Scheme End Semester**					
			L	**T**	**P**	**CA**	**TA**	**Total Internal**	**External**	**Total**	**Credit**
1	OE BT 3X	Open Elective III	2	1	0	20	20	40	60	100	3
2	OE BT 4X	Open Elective IV	3	0	0	20	20	40	60	100	3
3	PS 402	Project II	0	0	18	-	-	300	300	600	9
4		**MOOCs (Essential for Hons. Degree)**									
		Total	**5**	**1**	**18**					**800**	**15**

SEMESTER-VII

Course Code: PCC BT-701 **Course Name**: Data Analysis and Simulations
Course Credit Hour: 3Hr **Total Contact Hour**: 30hr

Course Objective:

In this course, the students will learn the principles and methods of statistical analysis, but will also put them into practice using a range of real-world data sets. The objective of the course is to provide a basic understanding of data analysis using statistics and to use computational tools on problems of applied nature. Applications of data science techniques such as machine learning, deep learning and their applications in biological data.

Data preprocessing and visualization: Types of data, dealing with missing data, data visualization: Scatter Plot, histogram, group plots, box plots etc., dimensionality reduction.

Data analysis: Statistical analysis, hypothesis testing, significance of p-value, chi-square, T-test, ANOVA, Bayesian Probability.

Mining Frequent Patterns: Associations and Correlations, Classification.

Machine learning: Supervised, unsupervised, logistic regression, SVMs, decision trees, clustering and model evaluation.

Artificial neural networks: Types of ANN, case studies for the application of deep learning in biology and health care research.

Practicals:

1. Plotting graphs using MS Excel.
2. Statistical data analysis using PSPP.
3. Implementing machine learning algorithms.
4. Deep learning using Deep Learning Studio Desktop.

Text Books/References:

5. Introduction to Machine Learning using Python, Jeeva Jose, Khanna Publishing House, 2019.
6. Data Mining: Concepts and Techniques by Jiawei Han, Jian Pei, Micheline Kamber, Elsevier; Third edition 2007.
7. Deep Learning by Ian Goodfellow, Yoshua Bengio, MIT Press 2017.
8. Data Visualization – A Practical Introduction by Kieran Healy, Princeton University Press 2019.
9. Deep Learning – Rajiv Chopra, Khanna Publishing House, 2019.

Course Outcomes:

On completion of this course, students will be able to gain insights such as correlation and basic analysis using data visualization. Students can present their research results in probabilistic terms using statistical significance. Students can build and train machine learning models and evaluate them; get accustomed with deep learning techniques and their applications in biological and healthcare data.

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: DE BT 4X (3) **Course Name:** Stem-Cell Technology
Course Credit Hour: 3Hr **Total Contact Hour**: 30hr

Course Objective(s):

To impart knowledge of wide-ranging topics related to stem cells and regenerative biology, including a brief history of the field, research on animal models of regeneration, tissue engineering, social and ethical issues related to stem cell research.

Course Content:

Introduction to Stem Cells: Principles and properties of stem cells, types of stem cells, comparison of embryonic and adult stem cells.

Stem Cell Niche: Introduction to stem cell niches in gut epithelium, bone marrow, epidermis, testis and neural tissues.

Cell Cycle and Development: Cell cycle regulators and checkpoints, cell fusion, differentiation of stem cells and their role in self-renewal.

Epigenetic Control: DNA-methylation and histone modifications, genomic imprinting, telomerase regulation, X-chromosome inactivation, reprogramming of cells, induced pluripotent stem cells and their therapeutic applications.

Types and Regeneration: Stem cells derived from amniotic fluid, extra embryonic membrane, germ cells, hematopoietic organs, neurons and kidney, cord blood transplantation, donor selection, HLA matching, patient selection, peripheral blood and bone marrow transplantation, bone marrow and cord blood collection procedures and cryopreservation and their applications.

Experimental Methods: Isolation and differentiation of human adult stem cells, embryonic stem cells and mouse stem cells, stem cell techniques: fluorescence activated cell sorting (FACS), time lapse video, green fluorescent protein tagging.

Applications: Stem cells applications in cancer, diabetes, heart disease, muscular dystrophy, regeneration of epidermis; stem cell regulations, debate, social and ethical concerns, Organ farming.

Practicals:

1. Colony formation assays
2. Culture of adult stem cells
3. Real Time PCR for stem cell markers
4. Western blot for stem cell markers
5. Adult stem cell differentiation and visualization by staining (Example: Adipocytes)

Text Books/References:

1. Hematopoietic Stem Cell Transplantation by Treleaven, J., first edition 2009.
2. Essentials of Stem Cell Biology by Lanza, R., second Edition, 2009 Academic Press.
3. Molecular Cell Biology by Lodish et al., sixth Ed., W.H. Freeman & Co. 2008.
4. Stem Cells: From Bench to Bedside by Bongso and Ariff.

Course Outcomes: The students will learn isolation, characterization, and applications of stem cells in Biotechnology.

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: DE BT 5X (3) **Course Name:** Waste Management & Upcycling

Course Credit Hour: 3Hr **Total**

Contact Hour: 30hr

Course Objective(s):

- To introduce fundamental aspects of types of waste and its management.
- To disseminate knowledge on various waste management technologies.
- To provide knowledge on how waste can be converted to wealth in a sustainable way.
- To enable students to think innovative way to develop concepts in waste management.

Course Content:

UNIT I

Waste management: The definition of waste, and its classification in the context of EU legislation, policy and other drivers for change, including the planning and permitting regime for the delivery of waste management solutions

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.

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 II

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 III

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.

UNIT IV

Interface of waste and resource management and civil engineering in the context of sustainable waste management in global cities and developing countries; and Use of

decision support tools including multi-criteria analysis, carbon foot-printing and life- cycle analysis, as appropriate.

UNIT V

Waster Upcycling, waste reuse, Waste down cycling, waste upcycling a social enterprise, Case study in each area. Innovative technologies for sustainable waste management.

Text Books/References:

O.P. Gupta, "Elements of Solid & Hazardous Waste Management", Khanna Publishing House, New Delhi, 2019.

George Tchobanoglous et.al., "Integrated Solid Waste Management", McGraw-Hill Publishers, 1993.

B.Bilitewski, G.HardHe, K.Marek, A.Weissbach, and H.Boeddicker, "Waste Management", Springer, 1994.

Course Outcomes:

- The students shall get an adequate knowledge on waste and its sustainable management.
- Students should get enough knowledge on safety guidelines of waste management.
- Students in groups shall develop concepts in managing waste of their institutions.
- Students should get experiential learning with a waste management company in the vicinity.

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: OE BT 2X (2) **Course Name:** Artificial Intelligence

Course Credit Hour: 3Hr **Total Contact Hour**: 30hr

Course Objective(s):

Artificial Intelligence is a major step forward in how computer system adapts, evolves and learns. It has widespread application in almost every industry and is considered to be a big technological shift, similar in scale to past events such as the industrial revolution, the computer age, and the smartphone revolution.

This course will allow gaining expertise in one of the most fascinating and fastest-growing areas of Computer Science through a classroom program that covers fascinating and compelling topics related to human intelligence and its applications in industry, defense, healthcare, agriculture, and many other areas. This course will give the students a rigorous, advanced and professional graduate-level foundation in Artificial Intelligence.

Course Contents:

Introduction

Concept of AI, history, current status, scope, agents, environments, Problem Formulations, Review of tree and graph structures, State space representation, Search graph and Search tree.

Search Algorithms

Random search, Search with closed and open list, Depth and Breadth first search, Heuristic search, Best first search, A* algorithm, Game Search.

Probabilistic Reasoning

Probability, conditional probability, Bayes Rule, Bayesian Networks- representation, construction and inference, temporal model, hidden Markov model.

Markov Decision process

MDP formulation, utility theory, utility functions, value iteration, policy iteration and partially observable MDPs.

Reinforcement Learning

Passive reinforcement learning, direct utility estimation, adaptive dynamic programming, temporal difference learning, active reinforcement learning- Q learning.

Practicals:

1. Write a programme to conduct uninformed and informed search.
2. Write a programme to conduct game search.
3. Write a programme to construct a Bayesian network from given data.
4. Write a programme to infer from the Bayesian network.
5. Write a programme to run value and policy iteration in a grid world.
6. Write a programme to do reinforcement learning in a grid world.
7. Mini Project work.

Text Books/References:

1. Stuart Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach", 3rd
2. Edition, Prentice Hall
3. Elaine Rich and Kevin Knight, "Artificial Intelligence", Tata McGraw Hill
4. Trivedi, M.C., "A Classical Approach to Artificial Intelligence", Khanna Publishing
5. House, Delhi.
6. Saroj Kaushik, "Artificial Intelligence", Cengage Learning India, 2011
7. David Poole and Alan Mackworth, "Artificial Intelligence: Foundations for Computational Agents", Cambridge University Press 2010.

Websites:

https://nptel.ac.in/courses/106105077
https://nptel.ac.in/courses/106106126
https://aima.cs.berkeley.edu
https://ai.berkeley,edu/project_overview.html (for Practicals)

Course Outcomes: After undergoing this course, the students will be able to:

- Build intelligent agents for search and games.
- Solve AI problems through programming with Python.
- Learning optimization and inference algorithms for model learning.
- Design and develop programs for an agent to learn and act in a structured environment.

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40%**

SEMESTER VIII

Course Code**: OE BT 31** **Course Name:** Robotics

Course Credit Hour: 3Hr **Total Contact Hour**: 30hr

Course Objective(s):
The objective of this course is to impart knowledge about industrial robots for their control and design.

Course Content:

Introduction to Robotics
Types and components of a robot, Classification of robots, closed-loop and open loop control systems. Kinematics systems; Definition of mechanisms and manipulators, Social issues and safety.

Robot Kinematics and Dynamics
Kinematic Modelling: Translation and Rotation Representation, Coordinate transformation, DH parameters, Jacobian, Singularity, and Statics
Dynamic Modelling: Equations of motion: Euler-Lagrange formulation

Sensors and Vision System
Sensor: Contact and Proximity, Position, Velocity, Force, Tactile etc.

Robotics Introduction to Cameras, Camera calibration, Geometry of Image formation, Euclidean/Similarity/Affine/Projective transformations
Vision applications in robotics.

Robot Control
Basics of control: Transfer functions, Control laws: P, PD, PID.
Non-linear and advanced controls.

Robot Actuation Systems
Actuators: Electric, Hydraulic and Pneumatic; Transmission: Gears, Timing Belts and Bearings, Parameters for selection of actuators.

Control Hardware and Interfacing
Embedded systems: Architecture and integration with sensors, actuators, components, Programming for Robot Applications.

Practicals:

1. Study components of a real robot and its DH parameters.
2. Forward kinematics and validate using a software (Robo Analyser or any other free software tool).
3. Inverse kinematics of the real robot and validation using any software.
4. Use of open source computer vision programming tool openCV.
5. Image Processing using openCV.
6. Image Processing for color/shape detection.
7. Positioning and orientation of robot arm.
8. Control experiment using available hardware or software.

9. Integration of assorted sensors (IR, Potentiometer, strain gages etc.), micro controllers and ROS (Robot Operating System) in a robotic system.
10. Project work

Text Books/References:

1. Saha, S.K., "Introduction to Robotics, 2nd Edition, McGraw-Hill Higher Education, New Delhi, 2014.
2. Ghosal, A., "Robotics", Oxford, New Delhi, 2006.
3. Niku Saeed B., "Introduction to Robotics: Analysis, Systems, Applications", PHI, New
4. Delhi.
5. Mittal R.K. and Nagrath I.J., "Robotics and Control", Tata McGraw Hill.
6. Mukherjee S., "Robotics Process Automation", Khanna Publishing House, Delhi.
7. Craig, J.J., "Introduction to Robotics: Mechanics and Control", Pearson, New Delhi,
8. 2009
9. Mark W. Spong, Seth Hutchinson, and M. Vidyasagar, "Robot Modelling and Control",
10. John Wiley and Sons Inc, 2005
11. Steve Heath, "Embedded System Design", 2nd Edition, Newnes, Burlington, 2003
12. Merzouki R., Samantaray A.K., Pathak P.M. and Bouamama B. Ould, "Intelligent Mechatronic System: Modeling, Control and Diagnosis", Springer.

Course Outcomes: After the completion of this course, the students will be able to:

- Perform kinematic and dynamic analyses with simulation.
- Design control laws for a robot.
- Integrate mechanical and electrical hardware for a real prototype of robotic device.
- Select a robotic system for a given application.

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: OE BT 32 **Course Name:** Food and Nutrition Technology

Course Credit Hour**: 3Hr** Total Contact Hour**: 30hr**

Course Objective(s):
The objectives of this course are to acquaint the students with recent advances in biotechnology in foods to produce new products with desirable characteristics. These include characteristics such as disease and drought-resistant plants, leaner meat and enhanced flavor and nutritional quality of foods.

Course Content:

Module 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.

Module 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.

Module 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-upstream and downstream processing application of microorganisms as starter cultures in meat industry, microbial production of food ingredients; Biosensors and novel tools and their application in food science.

Module 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.

Practicals:

1. Isolation of food borne bacteria (Campylobacter, Salmonella, Yersinia, E. coli) from various food sources using differential media.
2. Confirmation of food borne isolates by biotechnological tools.
3. Isolation and characterization of food borne viruses (rotavirus, hepatitis virus, polio virus, enterovirus) using biotechnological tools.

Text Books/References:

1. Potter, Norman. M. Food Science, 5th Ed. Springer US
2. Manay, S.; Shadakshara Swamy, M., (2004). Foods: Facts and Principles, 4 th Ed. New Age Publishers.
3. B. Srilakshmi., (2002) Food Science, New Age Publishers.

4. Meyer, (2004). Food Chemistry. New Age
5. Deman JM. (1990) Principles of Food Chemistry. 2 nd Ed. Van Nostrand Reinhold, NY
6. Ramaswamy H and Marcott M. Food Processing Principles and Applications. CRC Press

Course Outcomes:

On completion of this course, students should have gained knowledge about recent advances in biotechnology related to food technology.

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: OE BT 41 **Course Name: Bioterrorism and National Security**

Course Credit Hour**: 3Hr** Total Contact Hour**: 30hr**

Course Objective(s): Familiarization of issues involved and threats facing society due to bioterrorism and approaches to tackle it effectively.

Course Content:

Terrorism and Bioterrorism
Definition-Traditional Terrorists-New Terrorists-Nuclear, chemical, and radiological weapons-The psychology of Bioterrorism-Historical perspective.

Microbes and Immune System
Primary classes of Microbes-bacteria, virus, and other Agents-Immune system- Interaction between microbes and the immune system.

Bioterrorism Weapons and Techniques
Characteristics of microbes and the reasons for their Use-Symptoms-Pathogenicity- Epidemiology-natural and targeted release-The biological, techniques of dispersal, and case studies of Anthrax, Plague-Botulism, Smallpox, and Tularemia and VHF.

Prevention and Control of Bioterrorism
Surveillance and detection- Detection equipment and sensors –Diagnosis-Treatment- Vaccinations-Supplies- Effectiveness-Liability-Public Resistance-Response-First Responders-Infectious Control-Hospital-Prevention- Protection-Decontamination- Notification-Role of Law Enforcement-Economic impact.

Bioterrorism Management
Ethical issues: personal, national, the need to inform the public without creating fear, cost-benefit Rations-Information Management-Government control and industry Support-Microbial forensics.

Text Books:

1. Bioterrorism: Guidelines for Medical and Public Health Management, Henderson, Donald, American Medical Association, 1st Edition, 2002.
2. Biological Weapons: Limiting the Threat (BCSIA Studies in International Security), Lederberg, Joshua (Editor), MIT Press ,1999.
3. Bioterrorism and Infectious Agents: A New Dilemma for the 21st Century (Emerging Infectious Diseases of the 21st Century), I.W. Fong and Kenneth Alibek, Springer, 2005.

Reference Books:

1. The Demon in the Freezer: A True Story, Preston, Richard, Fawcett Books, 2003.
2. The Anthrax Letters: A Medical Detective Story, Cole, Leonard A., Joseph Henry Press, 2003.
3. Biotechnology research in an age of terrorism: confronting the dual use dilemma, National Academies of Science, 2003.

http://www.centerforhealthsecurity.org/our-work/pubs_archive/pubs-pdfs/2012/sloan_book/Preparing%20for%20Bioterrorism_Gigi%20Kwik%20Gronvall_December%202012.pdf

Course Outcomes:
Exposure to threats for national security, methods to tackle them and support law enforcement & health agencies to handle them.

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: OE BT 42 **Course Name:** Data Sciences

Course Credit Hour**: 3Hr** Total Contact Hour**: 30hr**

Course Objective(s):
The objective of this course is to impart the necessary knowledge of the mathematical foundations needed for data science and develop programming skills required to build data science applications.

Course Content:

Introduction to Data Science: Concept of Data Science, Traits of Big data, Web Scraping, Analysis vs Reporting.
Introduction to Programming Tools for Data Science:
Toolkits using Python: Matplotlib, NumPy, Scikit-learn, NLTK
Visualizing Data: Bar Charts, Line Charts, Scatterplots
Working with data: Reading Files, Scraping the Web, Using APIs (Example: Using the Twitter APIs), Cleaning and Munging, Manipulating Data, Rescaling, Dimensionality Reduction

Mathematical Foundations
Linear Algebra: Vectors, Matrices.
Statistics: Describing a Single Set of Data, Correlation, Simpson's Paradox, Correlation and Causation.
Probability: Dependence and Independence, Conditional Probability, Bayes's Theorem, Random Variables, Continuous Distributions, The Normal Distribution, The Central Limit Theorem.
Hypothesis and Inference: Statistical Hypothesis Testing, Confidence Intervals, P Hacking, Bayesian Inference.

Machine Learning
Overview of Machine learning concepts – Over fitting and train/test splits, Types of Machine learning – Supervised, Unsupervised, Reinforced learning, Introduction to Bayes Theorem, Linear Regression-model assumptions, regularization (lasso, ridge, elastic net), Classification and Regression algorithms-Naïve Bayes, K-Nearest Neighbors, logistic regression, support vector machines (SVM), decision trees, and random forest, Classification Errors, Analysis of Time Series- Linear Systems Analysis, Nonlinear Dynamics, Rule Induction, Neural Networks Learning And Generalization, Overview of Deep Learning.

Case Studies of Data Science Application
Weather forecasting, Stock market prediction, Object recognition, Real Time Sentiment Analysis.

Practicals:

1. Write a programme in Python to predict the class of the flower based on available attributes.
2. Write a programme in Python to predict if a loan will get approved or not.
3. Write a programme in Python to predict the traffic on a new mode of transport.
4. Write a programme in Python to predict the class of user.
5. Write a programme in Python to identify the tweets which are hate tweets and which are not.
6. Write a programme in Python to predict the age of the actors.
7. Mini project to predict the time taken to solve a problem given the current status of the user.

Text Books/References:

1. Joel Grus, "Data Science from Scratch: First Principles with Python", O'Reilly Media
2. Aurélien Géron, "Hands-On Machine Learning with Scikit-Learn and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems", 1st Edition, O'Reilly Media
3. Jain V.K., "Data Science & Analytics: Using Python, R and SPSS Programming", Khanna
4. Publishing House, Delhi.
5. Jain V.K., "Big Data and Hadoop", Khanna Publishing House, Delhi.
6. Jeeva Jose, "Introduction to Machine Learning using Python", Khanna Publishing
7. House, Delhi.
8. Chopra Rajiv, "Machine Learning", Khanna Publishing House, Delhi.
9. Ian Goodfellow, Yoshua Bengio and Aaron Courville, "Deep Learning", MIT Press

http://www.deeplearningbook.org

Jiawei Han and Jian Pei, "Data Mining Concepts and Techniques", Third Edition, Morgan Kaufmann Publishers.

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

1. Demonstrate understanding of the mathematical foundations needed for data science.
2. Collect, explore, clean, munge and manipulate data.
3. Implement models such as k-nearest Neighbors, Naive Bayes, linear and logistic regression, decision trees, neural networks and clustering.
4. Build data science applications using Python based toolkits.

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40%**

Course Code: OE BT 43 **Course Name:** Block Chain

Course Credit Hour**: 3Hr** Total Contact Hour**: 30hr**

Course Objective(s):

The objective of this course is to provide a conceptual understanding of how blockchain technology can be used to innovate and improve business processes. The course covers the technological underpinning of block Chain operations in both theoretical and practical implementation of solutions using block Chain technology.

Course Content:

Introduction
Introduction: Overview of Block chain, Public Ledgers, Bitcoin, Smart Contracts, Block in a Block chain, Transactions, Distributed Consensus, Public vs Private Block chain, Understanding Crypto currency to Block chain, Permissioned Model of Block chain, Overview of Security aspects of BlockChain.
Basic Crypto Primitives: Cryptographic Hash Function, Properties of a hash function, Hash pointer and Merkle tree, Digital Signature, Public Key Cryptography, A basic cryptocurrency.

Understanding Block chain with Crypto currency
Bitcoin and Block chain: Creation of coins, Payments and double spending, Bitcoin Scripts, Bitcoin P2P Network, Transaction in Bitcoin Network, Block Mining, Block propagation and block relay.
Working with Consensus in Bitcoin: Distributed consensus in open environments, Consensus in a Bitcoin network, Proof of Work (PoW) – basic introduction, Hashcash PoW, Bitcoin PoW, Attacks on PoW and the monopoly problem, Proof of Stake, Proof of Burn and Proof of Elapsed Time, The life of a Bitcoin Miner, Mining Difficulty, Mining Pool.

Understanding Block chain for Enterprises
Permissioned Block chain: Permissioned model and use cases, Design issues for Permissioned block chains, Execute contracts, State machine replication, Overview of Consensus models for permissioned block chain- Distributed consensus in closed environment, Paxos, RAFT Consensus, Byzantine general problem, Byzantine fault tolerant system, Lamport-Shostak-Pease BFT Algorithm, BFT over Asynchronous systems.
Enterprise application of Block chain: Cross border payments, Know Your Customer (KYC), Food Security, Mortgage over Block chain, Block chain enabled Trade, We Trade – Trade Finance Network, Supply Chain Financing, Identity on Block chain.

Block chain application development
Hyperledger Fabric- Architecture, Identities and Policies, Membership and Access Control, Channels, Transaction Validation, Writing smart contract using Hyperledger Fabric, Writing smart contract using Ethereum, Overview of Ripple and Corda.

Practicals:

1. Install and understand Docker container, Node.js, Java and Hyperledger Fabric, Ethereum and perform necessary software installation on local machine/create instance on Cloud to run.https://github.com/hyperledger/ https://docs.docker.com/get-started/ https://console.bluemix.net/docs/containers/container_index.html#container_i ndex

2. Create and deploy a block chain network using Hyperledger Fabric SDK for Java Set up and initialize the channel, install and instantiate chaincode, and perform invoke and query on your block chain network (https://developer.ibm.com/patterns/create-and-deploy-block chain-network- using-fabric-sdk-java/)
3. Interact with a block chain network. Execute transactions and requests against a block chain network by creating an app to test the network and its rules (https://developer.ibm.com/patterns/interacting-with-a-block chain-network/)
4. Deploy an asset-transfer app using block chain. Learn app development within a Hyperledger Fabric network (https://developer.ibm.com/patterns/deploy-an-asset- transfer-app-using-block chain/)

5. Use block chain to track fitness club rewards Build a web app that uses Hyperledger Fabric to track and trace member rewards (https://developer.ibm.com/patterns/fitness-club-rewards-points-iot-and-retail- integration/)
6. Car auction network: A Hello World example with Hyperledger Fabric Node SDK and IBM Block Chain Starter Plan. Use Hyperledger Fabric to invoke chaincode while storing results and data in the starter plan (https://developer.ibm.com/patterns/car- auction-network-hyperledger-fabric-node-sdk-starter-plan/)
7. Develop an IoT asset tracking app using Block chain. Use an IoT asset tracking device to improve a supply chain by using Block chain, IoT devices, and Node-RED (https://developer.ibm.com/patterns/develop-an-iot-asset-tracking-app-using- block chain/)
8. Secure art using block chain digital certificates. Node.js-based auction application can help democratize the art market (https://developer.ibm.com/patterns/securing-art- using-block chain-digital-certificates/)
9. Mini projects such as:

    i. Block chain for telecom roaming, fraud, and overage management. See how communication service providers use block chain to enhance their value chains. https://developer.ibm.com/patterns/block chain-for-telecom-roaming-fraud- and-overagemanagement/
    ii. Use IoT dashboards to analyze data sent from a Block chain network. Build an IoT app and IoT dashboards with Watson IoT Platform and Node-RED to analyze IoT data sent from a Block chain network https://developer.ibm.com/patterns/iot-dashboards-analyze-data-block chain-network/)
    iii. Create an Android app with Block chain integration. Build a Block chain enabled health and fitness app with Android and Kubernetes https://developer.ibm.com/patterns/create-an-android-app-with-block chain-integration/
    iv. Create a global finance block chain application with IBM Block chain Platform Extension for VS Code. Develop a Node.js smart contract and web app for a Global Finance with block chain use case https://developer.ibm.com/patterns/global-financing-use-case-for-block chain/
    v. Develop a voting application using Hyperledger and Ethereum. Build a decentralized app that combines Ethereum's Web3 and Solidity smart contracts with

Hyperledger's hosting Fabric and Chaincode EVM https://developer.ibm.com/patterns/voting-app-hyperledger-ethereum/

vi. Create a block chain app for loyalty points with Hyperledger Fabric Ethereum Virtual Machine. Deploy Fabric locally with EVM and create a proxy for interacting with a smart contract through a Node.js web app https://developer.ibm.com/patterns/loyalty-points-fabric-evm/

Text Books/References:

1. Melanie Swan, "Block Chain: Blueprint for a New Economy", O'Reilly, 2015
2. Josh Thompsons, "Block Chain: The BlockChain for Beginners- Guide to Block Chain Technology and Leveraging BlockChain Programming"
3. Daniel Drescher, "BlockChain Basics", Apress; 1stedition, 2017
4. Anshul Kaushik, "BlockChain and Crypto Currencies", Khanna Publishing House,
5. Delhi.
6. Imran Bashir, "Mastering BlockChain: Distributed Ledger Technology,
7. Decentralization and Smart Contracts Explained", Packt Publishing
8. Ritesh Modi, "Solidity Programming Essentials: A Beginner's Guide to Build Smart Contracts for Ethereum and Block Chain", Packt Publishing
9. Salman Baset, Luc Desrosiers, Nitin Gaur, Petr Novotny, Anthony O'Dowd, Venkatraman Ramakrishna, "Hands-On Block Chain with Hyperledger: Building Decentralized Applications with Hyperledger Fabric and Composer", Import, 2018.

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

1. Understand block chain technology.
2. Develop block chain based solutions and write smart contract using Hyperledger Fabric and Ethereum frameworks.
3. Build and deploy block chain application for on premise and cloud based architecture.
4. Integrate ideas from various domains and implement them using block chain technology in different perspectives.

Assessment method: (Continuous Internal Assessment = 40%, Final Examination = 60%)

Assignment -1	- 05%
Assignment -2	- 05%
Assessment-3(Mid-Exam)	- 20%
Assignment-3/Quiz-1	- 05%
Assignment-4	- 05%
Total Internal Assessment	**- 40%**