



**ख्वाजा मुईनुद्दीन चिश्ती भाषा विश्वविद्यालय, लखनऊ, उत्तर प्रदेश (भारत)**  
**Khwaja Moinuddin Chishti Language University, Lucknow, U.P. (India)**

U.P. STATE GOVERNMENT UNIVERSITY,  
(Recognised Under Section 2(f) & 12(B) of the UGC Act, 1956 & B.Tech. Approved by (AICTE))

---

## **FACULTY OF ENGINEERING & TECHNOLOGY**

**KHWAJA MOINUDDIN CHISHTI LANGUAGE  
UNIVERSITY, LUCKNOW, UTTAR PRADESH**

### **B.TECH. BIOTECHNOLOGY**

**Curriculum Structure**

**FOURTH YEAR**  
**(VII Semester)**



**ख्वाजा मुईनुद्दीन चिश्ती भाषा विश्वविद्यालय, लखनऊ, उत्तर प्रदेश (भारत)**  
**Khwaja Moinuddin Chishti Language University, Lucknow, U.P. (India)**

U.P. STATE GOVERNMENT UNIVERSITY,  
(Recognised Under Section 2(f) & 12(B) of the UGC Act, 1956 & B.Tech. Approved by (AICTE))

---

**Semester-VII**

**INDUSTRIAL BIOTECHNOLOGY**

**Course Objectives: •**

- Develop the understanding of industrial aspects of biotechnology.
- To give the details of herbal plants and to give details of diversity and conservation of natural resources.
- To recognize the properties of the basic industries and the environmental impact of waste generated is able to compare.
- To compare the methods used in wastewater treatment.

**Course Outcomes:**

- The recognition of medicinal plants, identification of adulteration and Contamination.
- Classification of Medicinal Plants, Phytochemistry, Carbohydrates, Lipids.
- Understand the production of Industrial products like metabolites, enzymes, and biofuels.
- Have information about treatment methods of waste generated in industries.
- To learn about the processing and technology for the production of fertilizers in agriculture.

**UNIT I**

Scope and importance, Commercial potential of Biotechnology in India. Historical overview of industrial fermentation process-traditional and modern Biotechnology. Industrial Fermentation-microorganisms, mode of operation, fermentation processes-pictorial representation.

**Unit II**

Herbal cosmetics, Coloring and Flavoring agents from plants; Utilization of aromatic plants and derived products with special reference to sandalwood oil, lemon grass oil and eucalyptus oil. Nutraceutical health foods (turmeric, garlic, Alfalfa, fenugreek, ginseng, ginkgo)

**UNIT III:**

Microbial polysaccharides, Biopesticides, Biofungicides, Herbicides, microbial flavors and fragrances and newer antibiotics and anticancer agents. Bio fertilizers and Bioremediation. Biotechnology in Agriculture: Ethical Aspects and Public Acceptance.

**UNIT IV**

Waste treatment technologies including waste incineration and energy from waste, advanced conversion technologies of pyrolysis and gasification, anaerobic digestion, composting and mechanical biological treatment of wastes. Landfill engineering and the management of landfill leachate and the mining of old landfills, concept of STP & ETP.

**UNIT V**

Process technology for the production of cell biomass (SCP), biofuels, biogas, bio-diesel, alcohol & dextran. Applications of bioconversion, biotransformation, enzyme and cell immobilization techniques in industry and its applications, enzymes in food technology.



**ख्वाजा मुईनुद्दीन चिश्ती भाषा विश्वविद्यालय, लखनऊ, उत्तर प्रदेश (भारत)**  
**Khwaja Moinuddin Chishti Language University, Lucknow, U.P. (India)**

U.P. STATE GOVERNMENT UNIVERSITY,  
(Recognised Under Section 2(f) & 12(B) of the UGC Act, 1956 & B.Tech. Approved by (AICTE)

---

**REFERENCE BOOKS:**

1. Biotechnology - a handbook of industrial microbiology: W. Crueger and A. Crueger.
2. Industrial Microbiology: L.E. Casida, Willey Eastern Ltd., 1989
3. S.S.Agrawal, Herbal drug technology, Universities press
4. A.R.Kashi, Industrial Pharmacognosy, Universities press
5. Microbial Biotechnology: Channarayaappa, University press, Hyderabad, 2003
6. George Tchobanoglous et al., "Integrated Solid Waste Management", McGrawHill 1993.
7. B.Bilitewski, G.HardHe, K.Marek, A.Weissbach, and H.Boeddicker, "Waste Management", Springer, 1994



**ख्वाजा मुईनुद्दीन चिश्ती भाषा विश्वविद्यालय, लखनऊ, उत्तर प्रदेश (भारत)**  
**Khwaja Moinuddin Chishti Language University, Lucknow, U.P. (India)**

U.P. STATE GOVERNMENT UNIVERSITY,  
(Recognised Under Section 2(f) & 12(B) of the UGC Act, 1956 & B.Tech. Approved by (AICTE)

---

### **INDUSTRIAL BIOTECHNOLOGY LAB**

1. Fermentative production of alcohol using microorganisms.
2. Preparation and efficacy of bio fertilizers in soil.
3. To Study the antimicrobial behavior of turmeric and garlic.
4. Visit to STP plant and prepare a report.
5. To test different water samples for TDS or to study the anti-inflammatory behavior of eucalyptus oil/sandalwood oil.
6. To study the nutraceutical /antioxidant properties of different food material.



## ख्वाजा मुईनुद्दीन चिश्ती भाषा विश्वविद्यालय, लखनऊ, उत्तर प्रदेश (भारत) Khwaja Moinuddin Chishti Language University, Lucknow, U.P. (India)

U.P. STATE GOVERNMENT UNIVERSITY,  
(Recognised Under Section 2(f) & 12(B) of the UGC Act, 1956 & B.Tech. Approved by (AICTE))

---

### **BIOSAFETY, BIOETHICS, IPR & PATENTS**

#### **Course Objectives:**

Develop the understanding of Intellectual property, IPR, Biosafety, GMO and bioethics

#### **Course Outcomes:**

- Would have a knowledge of Biosafety, GMOs and various Institutional committees
- Would demonstrate a clear understanding of Bioethics and its legal implications
- Develop an understanding of concept of Intellectual Property and its types
- Would have broad knowledge on of various types of IPRs, its protection and infringement
- Would demonstrate the understanding of International treaties and case studies

#### **Unit I: Biosafety-Regulatory Framework For GMOS in India**

Regulatory framework in India governing GMOs-Recombinant DNA Advisory Committee (RDAC), Institutional Biosafety Committee (IBC), Review Committee on Genetic Manipulation, Genetic Engineering Approval Committee (GEAC), State Biosafety Coordination Committee (SBCC), District Level Committee (DLC). Recombinant DNA Guidelines (1990), Revised Guidelines for Research in Transgenic Plants (1998), Seed Policy (2002), Prevention Food Adulteration Act (1955), The Food Safety and Standards Bill (2005), Plant Quarantine Order (2003), Regulation for Import of GM Products Under Foreign Trade Policy (2006-2007), National Environment Policy (2006). Rules for the manufacture, use/import/export and storage of hazardous microorganisms/genetically engineered organisms or cells (Ministry of Environment and Forests Notification, (1989).

#### **Unit II: Biosafety-Regulatory Framework For GMOS At International Level**

Convention of Biological Diversity (1992) – Cartagena Protocol on Biosafety – Objectives and salient features of Cartagena Protocol – Advanced Information Agreement (AIA) procedure – procedures for GMOs intended for direct use-risk assessment-risk management-handling, transport, packaging and identification of GMOs- Biosafety Clearing House-unintentional transboundary movement of GMOs-Benefits of becoming a party to the Cartagena Protocol- status of implementation in India.

#### **Unit III: Bioethics**

Distinction among various forms of IPR, ,Prior art for a patent, Patenting live microorganism, Human Genome project and ethical issues, Animal cloning, human cloning and their ethical issues, Experimenting on animals. Public education of producing transgenic organism, legal and socioeconomic impacts of biotechnology, testing drugs on human volunteers, Hazardous materials used in biotechnology, their handling and disposal.



## ख्वाजा मुईनुद्दीन चिश्ती भाषा विश्वविद्यालय, लखनऊ, उत्तर प्रदेश (भारत) Khwaja Moinuddin Chishti Language University, Lucknow, U.P. (India)

U.P. STATE GOVERNMENT UNIVERSITY,  
(Recognised Under Section 2(f) & 12(B) of the UGC Act, 1956 & B.Tech. Approved by (AICTE))

---

### **Unit IV: Intellectual Property Rights**

Concept of property, rights, duties and Jurisprudential definition, Introduction to patent, copy right, trademarks, Design, geographical indication. History and evolution of IPR, Economic importance of IPR, Indian patent act 1970 (amendment 2000), Distinction among various forms of IPR, invention step, biopiracy and bioprospecting- Appropriate case studies. Infringement/violation of patent, remedies against infringement (civil, criminal, administrative)

### **Unit V: Patents And Patent Laws**

Plant and Animal growers rights patents trade secrets, and plant genetic resources GATT and TRIPS, Dunkel's Draft Patenting of biological materials, Current Issues of Patents for higher animal and higher plants, patenting of transgenic organisms, isolated genes and DNA sequences.

### **REFERENCE/TEXT BOOKS:**

1. Beier, F.K., Crespi, R.S. and Straus, T. *Biotechnology and Patent protection*-Oxford and IBH Publishing Co. New Delhi.
2. Intellectual property rights and Bio-Technology (Biosafety and Bioethics), Anupam Singh, Ashwani Singh, NPH, New Delhi
3. Sasson A, *Biotechnologies and Development*, UNESCO Publications.
4. Singh K, *Intellectual Property rights on Biotechnology*, BCIL, New Delhi
5. *Regulatory Framework for GMOs in India* (2006) Ministry of Environment and Forest, Government of India, New Delhi





## ख्वाजा मुईनुद्दीन चिश्ती भाषा विश्वविद्यालय, लखनऊ, उत्तर प्रदेश (भारत) Khwaja Moinuddin Chishti Language University, Lucknow, U.P. (India)

U.P. STATE GOVERNMENT UNIVERSITY,  
(Recognised Under Section 2(f) & 12(B) of the UGC Act, 1956 & B.Tech. Approved by (AICTE))

### **BIOMARKER & DIAGNOSTICS**

#### **Course Objectives:**

- To familiarize the students with the principles & applications of the latest state-of-the-art biomarker discovery & bio-molecular diagnostic techniques used in laboratories the world over.
- The course will explore that how technological innovations fostered by the Human Genome Project, will lead to significant advances in our understanding of genetic diseases.

#### **Course Outcomes:**

- The students would be able to identify and analyze what biomarker based approach and methodology should be used for diagnostic purpose in different settings, their comparative advantages and limitations.
- Understand cancer types, their related genes & mitochondrial disorders
- Identification & Utilisation of biomarkers in diseases like cancer & neurodegeneration.
- The students would have in-depth knowledge of chromosome related diseases & sex-determination besides modern techniques used in the industry for diagnostics.
- Able to apply the knowledge of function genomics in public health.

#### **Unit – I**

**Introduction to Molecular Diagnostics:** History of diagnostics, Age of molecular diagnostics, Significance, Scope, Rise of diagnostic industry in Indian and global scenario, **Cellular Complexity:** Cell components, Cell Differentiation, Cellular communication – endocrine signalling, paracrine signalling and autocrine signalling, contact dependent and synaptic communications, Intracellular networks – transport pathways, signalling pathways and metabolic networks. Eukaryotic Cell Control System and their Components, Intracellular cell cycle control system, Extracellular Cell Cycle Control System, Regulation of Cell Growth and Apoptosis, Genetic and epigenetic factors that regulate these pathways, their abnormalities that alter the pathways and cellular functions.

#### **Unit – II**

**Molecular Oncology & Mitochondrial disorders:** Cancer – Benign and Malignant neoplasms, multifactorial disposition, Cancer pathogenesis, positive and negative mediators of neoplastic development, Proto-oncogenes, Oncogenes and Tumor suppressors. Allele loss and loss of Heterozygosity. Mitochondrial inheritance, Mitochondrial myopathy, lactic acidosis, MELAS, LHONs, identity testing.

#### **Unit – III**

**Biomarkers in disease diagnostics:** FDA definition of disease markers, Role of markers in Disease diagnosis. Approaches and methods in the identification of disease markers, predictive value, diagnostic value, emerging blood markers for sepsis, tumour & cancer markers, markers in inflammation and diagnosis of cytoskeletal disorders.



**ख्वाजा मुईनुद्दीन चिश्ती भाषा विश्वविद्यालय, लखनऊ, उत्तर प्रदेश (भारत)**  
**Khwaja Moinuddin Chishti Language University, Lucknow, U.P. (India)**

U.P. STATE GOVERNMENT UNIVERSITY,  
(Recognised Under Section 2(f) & 12(B) of the UGC Act, 1956 & B.Tech. Approved by (AICTE))

---

**Unit – IV**

**Chromosomes, Human disorders, and Cytogenetic analysis :**Structure, types and organization; Chromosome organization, Euchromatin and heterochromatin and Histone modifications. Chromosome banding and nomenclature; Nomenclature and functional significances of chromosome bands. GC and AT rich isochores. Structural and Numerical aberrations and its consequences. X-chromosome dosage compensation and inactivation mechanism. Sex determination and Y chromosome; function, and diseases. Uniparental disomy, Genomic Imprinting and disorders. FISH, CGH, Flow cytometry techniques and clinical diagnostics.

**Unit – V**

**Genomic instability, Chromosome mapping & Genome plasticity:** Common fragile sites and methods of induction, Heritable fragile sites and FXS. Genomic Instability, mechanism and diseases. Trinucleotide Repeats; Mechanism of expansion and triplet repeats and related disorders. Genetic linkage maps, Relation to the probability of recombination, Pedigree analysis with genetic markers and overview of human genome project.

**Text/References Books:**

1. Introduction to Tissue engineering, applications and challenges. Ravi Birla. Wiley Publications.
2. Principles of tissue engineering. Robert Lanza. Elsevier Publications.
3. Molecular Cell Biology: Darnell J, Lodish H and Baltimore D
4. Cell and Molecular Biology: De Robertis EDP and De Robertis EMF
5. Molecular Biology of the cell by Alberts et al., Garland Press
6. Genes IX, by Lewin B, Pearson India
7. Cell and Molecular Biology by De Robertis and De Robertis, Lipincott & Wilkins





# ख्वाजा मुईनुद्दीन चिश्ती भाषा विश्वविद्यालय, लखनऊ, उत्तर प्रदेश (भारत) Khwaja Moinuddin Chishti Language University, Lucknow, U.P. (India)

U.P. STATE GOVERNMENT UNIVERSITY,  
(Recognised Under Section 2(f) & 12(B) of the UGC Act, 1956 & B.Tech. Approved by (AICTE))

## **AGRICULTURE BIOTECHNOLOGY**

### **Course Objectives:**

- To give the details of plant cells and its functions
- To provide the basics of agrobacterium and applications of plant biotechnology
- The concept of Genetically modified organisms.
- Direct and indirect gene transfer methods in plants
- Transgenic plants: herbicide, pest and disease resistant, abiotic stress resistant, nutritional enhancement and traits for improved quality- Detection of GMOs – regulations and biosafety.

### **Course Outcomes:**

- Students learn about the setup of plant tissue culture lab their maintenance and preparation of tissue culture media (Both and solid and liquid media).
- In this student learn practically about surface sterilization techniques.
- Students practically handles the Induction of Root and Shoot and maintenance of callus.
- Students acquire knowledge in strain improvement which will be a demo experiment.
- Students handle practically in production of haploids.

### **UNIT I**

Agriculture and Agricultural Biotechnology, Clonal Germplasm: Micro propagation, In vitro production of pathogen and contaminant free plants

### **UNIT II**

Biotechnology- Methods of Crop Improvement: Genetic Engineering of Crop Plants, Transgenic Plants, Molecular Markers, QTL Mapping

### **UNIT III**

Microbes in Agriculture and Food: Applied Microbiology in the future of mankind, moving frontiers of applied microbiology, microbial enzymes and their applications in food processing and agro-chemical industries, agro-waste utilization, biodegradable polymers and their applications, microbial polysaccharides; Production and utilization of essential amino-acids, chemicals from micro-algae.

### **UNIT IV**

Metabolite Production: Production of Secondary Metabolites, Production of foreign compounds in transgenic plant, Achievements and recent developments of genetic engineering in agriculture

### **UNIT V**

Biofertilizers and Bioremediation: Microbial Biopesticides, Biofungicides, Herbicides, and Agricultural antibiotic Biotechnology in Agriculture: Ethical Aspects and Public Acceptance, Animal farming



**ख्वाजा मुईनुद्दीन चिश्ती भाषा विश्वविद्यालय, लखनऊ, उत्तर प्रदेश (भारत)**  
**Khwaja Moinuddin Chishti Language University, Lucknow, U.P. (India)**

U.P. STATE GOVERNMENT UNIVERSITY,  
(Recognised Under Section 2(f) & 12(B) of the UGC Act, 1956 & B.Tech. Approved by (AICTE))

---

**Reference Books:**

1. Biotechnology by B.D.Singh, Kalyani Publication
2. Biotechnology – Fundamentals and applications by S.S.Purohit, Student Edition
3. Agricultural Biotechnology-Arie Altman, CRC Press
4. Biotechnology- An Introduction by Susan R. Barnum, Vikas Publishing House



**ख्वाजा मुईनुद्दीन चिश्ती भाषा विश्वविद्यालय, लखनऊ, उत्तर प्रदेश (भारत)**  
**Khwaja Moinuddin Chishti Language University, Lucknow, U.P. (India)**

U.P. STATE GOVERNMENT UNIVERSITY,  
(Recognised Under Section 2(f) & 12(B) of the UGC Act, 1956 & B.Tech. Approved by (AICTE)

---

### **AGRICULTURE BIOTECHNOLOGY LAB**

1. Preparation of buffer and stock solution for plant tissue culture
2. Preparation of MSmedium (semi-solid) and sterilization process
3. Explant selection, preparation and surface sterilization.
4. To learn culturing and sub culturing
5. Initiation of callus cultures from different explants
6. Preparation of artificial seed/synthetic seed for conservation of germplasm
7. Extraction of plant genomic DNA/RNA and its estimation



## **ENTREPRENEURSHIP IN BIOTECHNOLOGY**

### **Course Objectives:**

- Understanding basic concepts in the area of entrepreneurship
- Understanding the role and importance of bio-entrepreneurship for economic development, developing personal creativity and entrepreneurial initiative,
- Adopting of the key steps in the elaboration of funding of the biotech business
- Understanding the stages of the entrepreneurial process and the resources needed for the start-up, successful development, quality control & export possibilities of biotech enterprises.

### **Course Outcomes:**

- Analyze the business environment in order to identify business opportunities,
- Identify the elements of success of bio-entrepreneurial ventures, consider the legal and financial conditions for starting a business venture,
- Evaluate the effectiveness of different bio-entrepreneurial strategies, specify the basic performance indicators of entrepreneurial activity,
- Explain the importance of marketing and management in small biotech businesses venture
- Interpret their own biotech business plan from start-up to setting-up to control to export

### **Unit-I**

Introduction: Entrepreneur, Creativity & Entrepreneurial personality and Entrepreneurship in Biotechnology, pillars of bio-entrepreneurship and major start-ups in Biotechnology, Concept and theories of Entrepreneurship, Entrepreneurial traits and motivation, Nature and importance of Entrepreneurs, Government schemes for commercialization of technology (eg. Biotech Consortium India Limited)

### **Unit-II**

Project management: Search for a business idea, concept of project and classification, project identification, project formulation, project design and network analysis, project report, project appraisal.

### **Unit-III**

Financial analysis: Ratio analysis, Investment process, Break even analysis, Profitability analysis, Budget and planning process.

### **Unit-IV**

Funding of biotech business(Financing alternatives, Venture Capital funding, funding for biotech in India, Exit strategy, licensing strategies, valuation), support mechanisms for entrepreneurship (Bio-entrepreneurship efforts in India, difficulties in India experienced, organizations supporting biotech growth, areas of scope, funding agencies in India, biotech policy initiatives)



**ख्वाजा मुईनुद्दीन चिश्ती भाषा विश्वविद्यालय, लखनऊ, उत्तर प्रदेश (भारत)**  
**Khwaja Moinuddin Chishti Language University, Lucknow, U.P. (India)**

U.P. STATE GOVERNMENT UNIVERSITY,  
(Recognised Under Section 2(f) & 12(B) of the UGC Act, 1956 & B.Tech. Approved by (AICTE))

---

**Unit-V**

Biotech enterprises: Desirables in start-up, Setting up Small, Medium & Large scale industry, Quality control in Biotech industries, Location of an enterprise, steps for starting a small industry, incentives and subsidies, exploring export possibilities

**Recommended Books:**

1. The Business of Biotechnology: From the Bench of the Street: By Richard Dana Ono Published Butterworth- Heinemann, 1991.
2. Entrepreneurship in Biotechnology: Managing for growth from start-up By Martin Gross Mann, 2003
3. Innovation and entrepreneurship in biotechnology: Concepts, theories & cases by D. Hyne & John Kapeleris, 2006
4. Dynamics of Entrepreneurial Development and Management by Vasant Desai, Himalaya Publishing House, 2005.
5. Projects Planning Analysis, Selection, Implementation & Review by Prasannan.
6. Best Practices in Biotechnology Education: By Yali Friedman, Published by Logos Press, 2008.



## ख्वाजा मुईनुद्दीन चिश्ती भाषा विश्वविद्यालय, लखनऊ, उत्तर प्रदेश (भारत) Khwaja Moinuddin Chishti Language University, Lucknow, U.P. (India)

U.P. STATE GOVERNMENT UNIVERSITY,  
(Recognised Under Section 2(f) & 12(B) of the UGC Act, 1956 & B.Tech. Approved by (AICTE))

---

### APPLICATIONS OF NATURAL PRODUCTS

#### **Course Objectives:**

- To give the details of herbal plants
- To give details of diversity and conservation of natural resources
- Basic concepts of Ethnobotany & Ethnopharmacology in drug discovery process
- Concept and application of secondary metabolites from plants

#### **Course Outcomes:**

- To know about what is the role of an individual in Conservation of Natural Resources.
- Herbal science and their Science.
- Classification of Medicinal Plants, Phytochemistry, Carbohydrates, Lipids,
- Terpenes, Polyphenols, Alkaloids, Pharmacology, Toxicity, Formulations and Preparations of Herbal Medicines.
- How herbs influence our physiology and can be helpful against several disorders.
- Relations between Phyto-therapy and the Elderly, Phytotherapy and Children, Understanding Herbal Action, and Understanding the Materia Medica.
- The recognition of medicinal plants, identification of adulteration and Contamination.
- Ethnobotany & Ethnopharmacology in drug discovery process.

#### **Unit-I**

Sources of crude drug: Biological, marine, Mineral and plant tissue culture as source of natural products. Various methods of extraction and isolation of phytopharmaceuticals namely infusion, decoction, maceration, percolation, hot continuous extraction, successive solvent extraction, supercritical fluid extraction, steam distillation, Counter-current Extraction, Ultrasound Extraction (Sonication). Parameters for selection of suitable extraction process.

#### **Unit-II**

Phytochemical Screening: Screening of alkaloids, saponins, cardenolides and bufadienolides, flavonoids and leucoanthocyanidins, tannins and polyphenols, anthraquinones, cynogenetic glycosides, amino acids in plant extracts. Important therapeutic classes: antimicrobial, antidiabetics, hepatoprotectives, immunomodulators, anti-cancer.

#### **Unit-III**

Herbal cosmetics: Importance of herbals as shampoos (soapnut), conditioners and hair darkeners, (amla, henna, hibiscus, tea), skin care (aloe, turmeric, lemon peel, vetiver); Colouring and Flavouring agents from plants; Utilization of aromatic plants and derived products with special reference to sandalwood oil, mentha oil, lemon grass oil, vetiver oil, geranium oil and eucalyptus oil.





## ख्वाजा मुईनुद्दीन चिश्ती भाषा विश्वविद्यालय, लखनऊ, उत्तर प्रदेश (भारत) Khwaja Moinuddin Chishti Language University, Lucknow, U.P. (India)

U.P. STATE GOVERNMENT UNIVERSITY,  
(Recognised Under Section 2(f) & 12(B) of the UGC Act, 1956 & B.Tech. Approved by (AICTE))

---

### Unit-IV

Nutraceuticals and Health Foods: Classification of Nutraceuticals, Health foods: Source, Chemical constituents, uses, actions and commercial preparations of health foods, Alfalfa, Bran, Angelica, Chamomile, Corn oil, Fenugreek, Ferverfew, Garlic, Ginseng, Ginkgo, Honey, Hops, Safflower oil, Soyabean Oil, Turmeric. Concept and examples of Adaptogens

### Unit-V

Quality control of herbal drugs as per WHO, AYUSH and Pharmacopoeial guidelines-Extractive values, ash values. Determination of heavy metals, insecticides, pesticides and microbial load in herbal preparations.

### Text / Reference Books:

1. Manual K. Lindsey, Plant Tissue Culture, Springer U.K. Wagner.
2. Wagner and Bladt, Plant Drug analysis, Springer U.K.
3. A.R.Kashi, Industrial Pharmacognosy, Universities press
4. S.S.Agrawal, Herbal drug technology, Universities press
5. Quality Standards of Indian Medicinal Plants, Vol 10, (ICMR), New Delhi, 2012.
6. Indian Herbal Pharmacopoeia, K. M. Varghese Co.Bombay.
7. Craker L., Herbs, Spices And Medicinal Plants, CBS Publishers
8. N.R. Krishnaswamy Chemistry of Natural Products: A Unified Approach, University Press (India) Ltd., Orient Longman Limited, Hyderabad, 1999.



## ख्वाजा मुईनुद्दीन चिश्ती भाषा विश्वविद्यालय, लखनऊ, उत्तर प्रदेश (भारत) Khwaja Moinuddin Chishti Language University, Lucknow, U.P. (India)

U.P. STATE GOVERNMENT UNIVERSITY,  
(Recognised Under Section 2(f) & 12(B) of the UGC Act, 1956 & B.Tech. Approved by (AICTE))

---

### **WASTE TREATMENT AND MANAGEMENT**

#### **Course Objectives:**

- To give the details of water pollution
- recognize the properties of the basic industries and the environmental impact of waste generated is able to compare.
- define the characteristics of industrial waste water.
- explain the principles of industrial waste water refining.
- determine the appropriate treatment methods for textile industry waste water.
- recognize the food industry, the properties of wastes and waste resources.
- explain the food industry wastes treatment methods.
- compare the methods used in wastewater treatment and waste containing heavy metals such as metal plating and refinery.

#### **Course Outcomes:**

- Compare the methods of textile industry wastewater treatment.
- Make the selection process for high organic load of waste water treatment needed.
- Have information about treatment methods, pharmaceutical industry and the chemical (phenol) facilities which produces of wastewater properties of, operational problems.
- To find and implement scientific, technological, economic solutions to environmental problems.
- To know about the interrelationship between living organisms and environment.
- To know about the various social issues.

#### **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.

#### **UNIT II**

Waste treatment technologies including waste incineration and energy from waste, advanced conversion technologies of pyrolysis and gasification, anaerobic digestion, composting and mechanical biological treatment of wastes.

#### **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.



**ख्वाजा मुईनुद्दीन चिश्ती भाषा विश्वविद्यालय, लखनऊ, उत्तर प्रदेश (भारत)**  
**Khwaja Moinuddin Chishti Language University, Lucknow, U.P. (India)**

U.P. STATE GOVERNMENT UNIVERSITY,  
(Recognised Under Section 2(f) & 12(B) of the UGC Act, 1956 & B.Tech. Approved by (AICTE))

---

**UNIT IV**

Specific waste streams including healthcare wastes, food wastes, mineral and mining wastes, hazardous wastes and producer responsibility wastes; Sustainability and resource efficiency with consideration for materials flow through the economy, steps towards designing out waste and maximizing the value of outputs from waste treatment processes;

**UNIT V**

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.

**TEXT BOOKS**

1. George Tchobanoglous et.al., “Integrated Solid Waste Management”, McGraw-Hill Publishers, 1993.
2. B.Bilitewski, G.HardHe, K.Marek, A.Weissbach, and H.Boeddicker, “Waste Management”, Springer, 1994.



# ख्वाजा मुईनुद्दीन चिश्ती भाषा विश्वविद्यालय, लखनऊ, उत्तर प्रदेश (भारत) Khwaja Moinuddin Chishti Language University, Lucknow, U.P. (India)

U.P. STATE GOVERNMENT UNIVERSITY,  
(Recognised Under Section 2(f) & 12(B) of the UGC Act, 1956 & B.Tech. Approved by (AICTE))

---

## NANO BIOTECHNOLOGY

### Course objectives

- To introduce the concept of nanotechnology and nano-size
- To gain knowledge on the synthesis and characterization of nanomaterials
- To have awareness about different types of Nanostructures
- To get familiarize with applications of nanobiotechnology in different fields

### Course Outcomes

- Discuss the concept, synthesis & implications of nanotechnology.
- Interpret various types of nanostructures and their synthesis.
- Understand methods used for characterization of nanomaterials & its role in diagnostics.
- To learn the general applications of nano-based biomedical polymers.
- Outline of the current applications of nanobiotechnology

### UNIT-I

Nanobiotechnology, History, Origin, Fundamental Concepts, Bottom-up versus Top-down approaches, Discussion on Micro and Nanofabrication, Current research, Tool and Techniques, Applications and Implications and Nanofabrication.

### UNIT-II

Carbon nanotubes and related structures, Properties, Synthesis, Applications, Metal nano particles types and their synthesis, Application of Gold, Silver and Zinc oxide nanoparticles and Nano chemicals.

### UNIT-III

Atomic force microscopy (AFM), Scanning tunneling microscopy (STM), improved nano diagnostic devices, Drug delivery tools through nanotechnology

### Unit IV

Synthesis and characterization of different classes of biomedical polymers- their uses in pharmaceutical, cardiovascular ophthalmologic orthopedic areas.

### UNIT-V

Micro and Nano biosensor, Bioavailability, Nanoimaging agents, Tumor Targeting through nanotechnology, Quantum dots technology and its applications



**ख्वाजा मुईनुद्दीन चिश्ती भाषा विश्वविद्यालय, लखनऊ, उत्तर प्रदेश (भारत)**  
**Khwaja Moinuddin Chishti Language University, Lucknow, U.P. (India)**

U.P. STATE GOVERNMENT UNIVERSITY,  
(Recognised Under Section 2(f) & 12(B) of the UGC Act, 1956 & B.Tech. Approved by (AICTE))

---

**TEXT BOOK:**

1. Nanotechnology by Mark Ratner and Daniel Ratner, Pearson Education
2. Guozhong Cao ,”*Nanostructures and Nanomaterials , synthesis , properties and applications*” , Imperial College Press ,2004.
3. Hari Singh Nalwa, “*Nanostructured Materials and Nanotechnology*”, Academic Press, 2002
4. MEMS and nanotechnology – Based sensors and devices communication, Medical and Aerospace applications - A.R.Jha.
5. Mihail C. Roco and William Sims Bainbridge, “Nanotechnology: Societal Implications II – Individual Perspectives“, Springer Publishers, Sponsored by National Science Foundation, ISBN-10 1-4020-4658-8.