



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))

Detail Syllabus of B.Sc. II Year

or

Diploma in Microbial Technology



ख्वाजा मुईनुद्दीन चिश्ती भाषा विश्वविद्यालय, लखनऊ, उत्तर प्रदेश (भारत)
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Programme/Class: Diploma	Year: Second	Semester: Third
Subject: MICROBIOLOGY		
Course Code: B080301T	Course Title: Basic Biochemistry and Microbial Physiology	
Course Outcomes:		Bloom's Taxonomy
CO1- Will have understanding of the basic principles of thermodynamics applied to biological systems		K1, K3
CO2- Will be conversant with the structures of carbohydrates, lipids, proteins and nucleic acids		K2, K4
CO3- Will comprehend the basic concepts of enzyme biochemistry including enzyme kinetics, and will become aware of different variants of enzymes found in living cells.		K3, K5
CO4- Will be acquainted with the diverse physiological groups of bacteria/archaea and microbial transportsystems.		K3, K6
CO5- Will have an in-depth knowledge of patterns of bacterial growth, bacterial growth curve, calculation of generation time and specific growth rate, and effect of the environment on growth.		K2, K4
CO6- Will apprehend how biochemical pathways are used by bacteria for energy generation and conservation during growth on glucose under aerobic and anaerobic conditions		K3, K5
CO7- Will be familiar with the physiology of nitrogen fixation and assimilation of inorganic nitrogen by bacteria and understand how interactions between microbes and the environment affect cellular physiology.		K4, K6
Credits: 4		Core: Compulsory
Max. Marks: 25+75		Min. Passing marks: as per rules
Total No. of Lectures-Tutorials-Practical (in hours per week):L-T-P:4-0-0		
Unit	Topics	Total No. of Lectures/ Hours (60)
I	Overview of thermodynamics and bioenergetic Basics of thermodynamics- First and second laws, concept of enthalpy, entropy, free energy change, standard free energy change, equilibrium constant and spontaneous reactions and coupled reactions	6
II	Water & Carbohydrates Structure and properties of water, Handerson Hasselbalch equation, Ionic product of water, pH and buffers. Structure & classification of carbohydrates, carbohydrates metabolism: glycolysis, fermentation, Pentose phosphate pathway (PPP), Entner Doudoroff pathway, Krebs Cycle, Electron transport chain (ETC)-	12



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	Chemiosmotic hypothesis, oxidative phosphorylation and ATP generation, Gluconeogenesis	
III	Proteins Structure & Classification- Protein structure: primary, secondary- peptide unit salient features, α helix, β sheet, β turn, tertiary and quaternary-human hemoglobin as an example. Forces involved in protein folding	6
IV	Lipids & Nucleic acids Structure and classification of lipids. Metabolism of lipids- Alpha and beta oxidation of lipids; Nucleic acids Structures, Double helical structure of DNA. Types of DNA: A, B, Z. Physic-chemical properties of DNA. RNA types- rRNA, mRNA, tRNA.	6
V	Enzymology concepts: Concepts of holozymes, apoenzyme, cofactors, prosthetic group, coenzyme, metal cofactors; Classification of enzymes; Active site and activation energy; Lock and key hypothesis, induced fit hypothesis; enzyme kinetics; Allosteric enzymes-cooperativity; Enzyme inhibition: competitive and noncompetitive	6
VI	Microbial nutrient uptake and transport: Microbial classification based on nutrient and energy source; Nutrient uptake mechanisms-passive and facilitated diffusion; Primary and secondary active transport; Concept of uniport, symport, antiport, group translocation; Iron uptake	8
VII	Microbial growth and effect of environmental factors on growth Bacterial growth curve and kinetics-Generation time and specific growth rate; Diauxic growth and synchronous growth; Batch, Fed batch and continuous cultures; Chemostat and turbidostat	8
VIII	Stress physiology and Nitrogen metabolism Effect of oxygen, pH, osmotic pressure, heat shock on bacteria; Microbial adaptation to Environment-Temperature, pH, Oxygen, Pressure, Salt, Water activity; Extremophiles application in industry; Dissimilatory nitrate reduction, Nitrogen fixation	8



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Suggested Readings:

Moat A.G., Foster J.W. and Spector M.P. 2002. *Microbial Physiology*, 4th edition. A Johan Wiley and sons inc., publication.
Kim B.H. and Gadd G.M. 2008. *Bacterial physiology and metabolism*. Cambridge University Press, Cambridge.
Gilbert H.F. 2000. *Basic concepts in biochemistry: A student's survival guide*. Second Edition. Mc-Graw- Hill Companies, health professions Division, New York.
Madigan M.T., Martinko J.M., Stahl D.A. and Calrk D.P. 2012. *Brock Biology of Microorganisms*. 13th ed. Pearson Education Inc.
Jeremy M. Berg, John L. Tymoczko, Gregory J. Gatto Jr., Lubert Stryer.2015. *Biochemistry* 8th edition. W. H. Freeman.
Suggestive digital platforms web links-
<https://lipidnanostructuresgroup.weebly.com>
<https://www.labster.com/microbiology-virtual-labs>
<https://www.microbiologybook.org>
<https://www.cpe.rutgers.edu/courses/current/lf0401wa.html>
<https://www.sciencedirect.com/topics/earth-and-planetary-sciences/microscopy>
<https://www.futurelearn.com/courses/introduction-to-microbiology>

This course can be opted as an elective by the students of following subjects: Open for all

Course prerequisites: To study this course, a student must have had the subject “Agriculture and Environmental Microbiology” in II Semester of certificate course in Microbial Technology

Suggested Continuous Evaluation Methods House Examination/Test:10 marks

Written Assignment/Presentation/Project/Research Orientation/Term papers/Seminar: 10 Marks

Classperformance/Participate: 5Marks

Further Suggestions: None



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Programme/Class: Diploma	Year: Second	Semester: Third
Subject: MICROBIOLOGY		
Course Code: B080302P	Course Title: Experiments in Basic Biochemistry and Microbial Physiology	
Course Outcomes:		Bloom's taxonomy
CO1- Understand the structures of carbohydrates and their main properties, as well as conduct chemical tests to detect their presence in samples.		K1, K3
CO2- Would have acquired practical knowledge of biochemical techniques for proteins and will be familiar with the use of a spectrophotometer.		K4, K5
CO3- Understand the fundamental principles of enzyme biochemistry, including enzyme kinetics, at the end of the course.		K2, K6
CO4- Will have a thorough understanding of bacterial growth patterns, bacterial growth curves, generation time and basic growth rate calculations, and the impact of the environment on growth.		K3, K5
CO5- Will learn about the fermentation process in microbes.		K1, K3
Credits: 2	Core: Compulsory	
Max. Marks: 25+75	Min. Passing marks: as per rules	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P:0-0-2		
S. No.	Objectives	Total No. of Lectures/ Hours (60)
1	Use and calibration of pH meter and preparation of buffers. Preparation of stock and working solutions. Handling of pipettes and micropipettes and checking their accuracy.	4
2	Qualitative tests Carbohydrates: Molisch's Test, Fehling's Test, Benedict's Test, Iodine Test) Amino acids and Proteins: Ninhydrin test, Biuret test, Lowry's assay. Lipids: Solubility Test, Translucent Spot Test, Emulsification Test.	20
3	Quantitative estimation of carbohydrate by anthrone method. Quantitative estimation of proteins by Lowry's method Determination of the acid value of a fat	10
4	Amylase production, H ₂ S production, Urease production test, IMViC test	10
5	Effect of temperature and pH on growth of E. coli, Effect of carbon and nitrogen on microbial growth.	8
6	Demonstration of carbohydrate fermentation, indole production, catalase test, oxidase test.	8



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Suggested readings:

Daniel M. Bollag, Stuart J. Edelstein, Protein Methods, Volume 1, 1991, Wiley.
S. K. Sawhney, Randhir Singh, Introductory Practical Biochemistry, 2000, Narosa.
Sambrook J and Russell DW., Molecular Cloning: A Laboratory Manual. 4th Edition, 2004, Cold Spring Harbour Laboratory press.
Maloy SR, Cronan JE and Friefelder D, Microbial Genetics 2nd EDITION., 2004, Jones and Barlett Publishers
Larry Snyder. Molecular Genetics of Bacteria: 3rd (third) Edition.

Digital links

<http://www.mooc.list.com/tag/molecular-biology>

<http://www.mooc.list.com/course/microbiology.sayloro>

<https://lipidnanostructuresgroup.weely.com>

<http://www.mooc.list.com/microbial>

<https://open.umn.edu/opentextbooks/textbooks/biochemistry-free-for-all-ahern>

This course can be opted as an elective by the students of following subjects: Open for all

Course prerequisites: To study this course, a student must have had the subject “Agriculture and Environmental Microbiology” in II Semester of certificate course in Microbial Technology

Suggested Continuous Evaluation Methods

Further Suggestions: None



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FACULTY OF SCIENCE

KHWAJA MOINUDDIN CHISTI LANGUAGE UNIVERSITY, LUCKNOW, U.P. (India)

B.Sc. - Microbiology (2nd Year, Semester-III or IV) Generic Elective-3 or 4 (GE-3/4)/Minor Elective-3 or 4

Minor Microbiology-3 or 4

Microbial ecology and Bio control by Microorganism Effective from Session 2022-23



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Programme/Class: Certificate	Year: Second	Semester: Third or Fourth
Subject: Microbiology		
Course Code: B080203T	Course Title: Microbial ecology and Bio control by Microorganism	
Course Outcomes:		Bloom's taxonomy
CO1- Get acquainted with natural habitats of diverse protection.		K1, K4
CO2- Understand how microbes interact among themselves and with higher plants and animals with the help of various examples.		K2, K4
CO3- Become aware of the important role microbes play in bio-geochemical cycling of essential elements occurring within an ecosystem and its significance.		K2, K5
CO4- Gain in depth knowledge of different types of solid waste, liquid waste and their management.		K3, K5
CO5- Get familiar with problems of pollution and applications of clear up technologies for the pollutants.		K3, K6
Credits: 4	GE-3 and 4/Minor Elective-3 and 4	
Max. Marks: 25+75	Min. Passing marks: as per rules	
Total No. of Lectures-Tutorials-Practical(in hours per week): L-T-P: 4-0-0		
Unit	Topics	Total No. of Lectures/ Units & Hours (60)
I	Interaction of Microorganisms- Positive and negative interactions among microorganisms. Types of interactions: Mutualism, Synergism, Commensalism, Competition, Amensalism, Parasitism and Predation. Microorganisms of rhizosphere, rhizoplane and phylloplane. Mycorrhiza – types and applications.	15
II	Carbon Cycle-Biogeochemical cycling of carbon. Microbial degradation of cellulose, hemicellulose, lignin and chitin. Role of microorganisms in carbon transformation and mineralization.	15
III	Nitrogen Cycle-Microbial role in nitrogen cycling. Nitrogen fixation (symbiotic and non-symbiotic). Ammonification, nitrification, denitrification and nitrate reduction.	15
IV	Phosphorus and Sulphur Cycles- Phosphorus cycle – phosphate immobilization and solubilization. Sulphur cycle – forms of sulphur and microorganisms involved in sulphur transformations.	15
V	Biodegradation- Concept and importance of biodegradation. Biodegradation of hydrocarbons, pesticides and herbicides. Role of microorganisms in degradation of environmental pollutants.	15



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VI	Bioremediation- Concept and scope of bioremediation. Types of bioremediation: microbial bioremediation, phytoremediation and mycoremediation. Types of reactions involved in bioremediation. Factors affecting microbial bioremediation – biotic (biological) and abiotic (environmental) factors.	15
Suggested Readings: Alexander M., Introduction to soil microbiology, Wiley Eastern limited, New Delhi. Alexopoulos C.J. and MIMS C.W., Introductory Mycology, New age international, New Delhi. Aneja K.R., Experiments in Microbiology, plant pathology, Tissue culture and Mushroom cultivation, New Age International, New Delhi Hurst, C.J., Environmental Microbiology, ASM press, Washington D.C. Mehrotra A.S., Plant Pathology, Tata Mcgraw Hill Publications limited, New Delhi. Pelczar M.J., Chan E.C.S and Kreig N.R., Microbiology, Mcgraw-Hill Book Company, New York. Prescott Lansing M., Harley John P. and Klein Donald A., Microbiology, WCB Mcgraw- Hill, New York. Salle A.J., Fundamental Principles of Bacteriology, Tata Mcgraw-Hill Publishing Company Limited, New Delhi. Stacey R.H. and Evans H.J., Biological Nitrogen Fixation, Chapman and Hall limited, London. Stanier R.Y., Ingraham J.L., General Microbiology, Prentice Hall of India Private Limited, New Delhi. Subbarao N.S., Soil Microroganisms and Plant Growth, Oxford and IBH Publishing Company, New Delhi.		
This course can be opted as an elective by the students of following subjects: Open for all The eligibility for this paper is 10+2 with any subject		
Suggested Continuous Evaluation Methods: <input type="checkbox"/> Seminar/ Presentation on any topic of the above syllabus <input type="checkbox"/> Test with multiple choice questions/ short and long answer questions Attendance		
Course prerequisites: To study this course, a student must have had the subject ALL in class 12th . The eligibility for this paper is 10+2 with any subject		
Further Suggestions: It widens the scope for students to join Government and Non-Government organization upskilling the people at different levels as per their socio-economic structure		
At the End of the whole syllabus any remarks/ suggestions:		



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B.Sc. - Microbiology (2nd Year, Semester-III) (SEC-3)/Vocational Course-3

Microbial production of Antibiotics and Organic Acids

Effective from Session 2023-2024



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Programme/Class: Certificate	Year: Second	Semester: Third
Subject: Microbiology		
Course Code: B080303T	Course Title: Microbial production of Antibiotics and Organic Acids	

Course Outcomes:	Bloom's taxonomy
CO1- Upon completion the students will learn about the role of Microorganism in protection.	K1, K3
CO2- Assimilate knowledge about Microbial Examination of secondary metabolites.	K4, K5
CO3- Learn about fermentation techniques.	K2, K6
CO4- Will get sufficient knowledge regarding analysis of antibiotic and acids.	K3, K5
Credits: 3	SEC-3/Vocational Course-3
Max. Marks: 40+60	Min. Passing marks: as per rules

Total No. of Lectures- Tutorials- Practical (in hours per week): **L-T-P:3-0-0**

Unit	Topics	Total No. of Lectures/ Unit & Hours (45)
I	Antibiotics (General)- History of antibiotics discovery, Wide range of antibiotics (Broad spectrum and narrow spectrum antibiotics), Microorganism producing antibiotics, Application of antibiotics (Antitumor, food preservative, antibiotics used in animal feed and veterinary medicine, control of plant diseases, tools in molecular biology)	15
II	Production of Antibiotics-Penicillins, Action of penicillins, Organism for penicillin production, Biosynthesis of penicillin, Production process of penicillin, Recovery of penicillin, Recovery of 6- amino penicillanic acid	15
III	Citric Acid- Application of citric acid, Microbial strains for citric acid production, Microbial biosynthesis of citric acid, Factors in the regulation of citric acid production	8
IV	Gluconic acid- Application of gluconic acid, Microbial production of gluconic acid, Production process for gluconic acid, Acetic acid- Microorganism used for production, Production process for acetic acid, Production of vinegar	7

Suggested Readings:

Adams & Moss, Food Microbiology, Published by Royal Society of Chemistry, Cambridge, U.K.
 R.S. Mehrotra – Plant Pathology, Tata Mc-Graw Hill
 Frazier & Westhoff., Food Microbiology Tata Mc-Graw Hill (2014)
 Varnam A.H. & Evans M G – Food borne pathogens. Wolfe Publishing House, London
 B.D. Singh (2015) Biotechnology, Kalyani Publisher
 Prajapati (2007) Fundamentals of Dairy microbiology, Indian Council of Agricultural Research, NewDelhi
 Andrew Proctor (2011) Alternatives to conventional food processing, RSC Publisher
 Arun K. Bhunia & Bibek Ray, Fundamental Food Microbiology, 5th Ed., CRC Press



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This course can be opted as an elective by the students of following subjects: Open for all The eligibility for this paper is 10+2 with any subject

Suggested Continuous Evaluation Methods: Seminar/ Presentation on any topic of the above syllabus
 Test with multiple choice questions/ short and long answer questions Attendance

Course prerequisites: To study this course, a student must have had the subject ALL in class 12th . The eligibility for this paper is 10+2 with any subject

Further Suggestions: It widens the scope for students to join Government and Non-Government organization upskilling the people at different levels as per their socio-economic structure.

At the End of the whole syllabus any remarks/ suggestions:



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Programme/Class: Diploma		Year: Second	Semester: Fourth
Subject: MICROBIOLOGY			
Course Code: B080401T		Course Title: Molecular Biology and Microbial Genetics	
Course Outcomes:			Bloom's taxonomy
CO1- Distinguish in prokaryotic cellular structure and functional components of cells, as well as the dissimilarities in genome organization between prokaryotes and eukaryotes.			K2, K3
CO2- Describe the replication, transmission, and action mechanisms of chromosomal and extrachromosomal genes and sequences.			K4, K5
CO3- Recognize and distinguish genetic regulatory mechanisms at various levels			K2, K5
CO4- Gain an understanding of how internal and external signals regulate gene expression, influence microbial diversity, and shape microbial communities and their environments.			K3, K5
CO5- Describe the processes that lead to mutations and other genetic changes.			K4, K6
Credits: 4		Core: Compulsory	
Max. Marks: 25+75		Min. Passing marks: as per rules	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 4-0-0			
Unit	Topics	Total No. of Lectures/ Hours (60)	
I	Overview of the genome organization – DNA/and RNA as genetic material, DNA double helix structure salient features, types of DNA. RNA Structure. Denaturation and renaturation, cot curves. DNA topology: linking number, topoisomerases. DNA organization in prokaryotes, viruses, eukaryotes.	6	
II	DNA Replication in Prokaryotes and Eukaryotes- Bidirectional and unidirectional replication, semi-conservative and semi-discontinuous replication. Mechanism of DNA replication, Replication of chromosome ends.	6	
III	Transcription in Prokaryotes and Eukaryotes Concept of transcription unit. General transcription process in prokaryotes and eukaryotes; Post-Transcriptional modification in eukaryotes, Alternative splicing mechanism, RNA interference	8	
IV	Translation in prokaryotes and eukaryotes Ribosome structure, tRNA structure and processing, Mechanisms of translation in both prokaryotes and eukaryotes, Genetic code, Wobble hypothesis, Fidelity of translation	8	



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V	Regulation of gene expression in prokaryotes and eukaryotes Overview of regulation of gene expression, Regulation of gene expression by DNA methylation, histone acetylation and histone methylation mechanisms; Transcription control mechanisms, Inducible Operon System, Repressible Operon System, Translation control mechanisms.	10
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VI	Plasmids in prokaryotes and eukaryotes Plasmid replication and partitioning, host range, plasmid incompatibility, plasmid amplification, regulation of plasmid copy number, curing of plasmids. Types of plasmids.	6
VII	Bacterial gene exchange processes- Mechanisms of Genetic Exchange, Horizontal gene transfer, Transformation; Conjugation; Transduction, Complementation.	8
VIII	Mutations, mutagenesis and repair Types of mutations, Physical and chemical mutagens. Loss and gain of function mutants. Reversion and suppression, Uses of mutations. Ames Test, DNA repair mechanism	8
<p>Suggested Readings: Watson, J. et. Al. 2004. Molecular Biology of the Gene, 5th Edition, CSHL Press, New York. Conn, E., & Stumpf, P. 2009. Outlines of Biochemistry, 5th Ed. Wiley India Pvt. Limited. T A Brown. 2001. Essential Molecular Biology. Oxford University Press, USA Brock, T.D. 1990. The Emergence of Bacterial Genetics, Cold Spring Harbor Lab Press. Ptashne, M. 2002. Genes and Signals, Cold Spring Harbor Laboratory Press. Miller, J.R. 1992. A Short Course in Bacterial Genetics: Lab Manual, Cold Spring Harbor Laboratory Press Suggestive digital platforms web links- https://www.classcentral.com/tag/microbiology http://www.mooc.list.com/tag/molecular-biology http://www.mooc.list.com/course/microbiology.sayloro https://lipidnanostructuresgroup.weely.com http://www.mooc.list.com/microbial https://open.umn.edu/opentextbooks/textbooks/biochemistry-free-for-all-ahern</p>		
<p>This course can be opted as an elective by the students of following subjects: Open for all </p>		
<p>Course prerequisites: To study this course, a student must have had the subject “Basic Biochemistry and Microbial Physiology” in III Semester of Diploma course in Microbial Technology</p>		
<p>Suggested Continuous Evaluation Methods House Examination/Test: 10 marks Written Assignment/Presentation/Project/Research Orientation/Term papers/Seminar: 10 marks Class performance/Participate: 5Marks</p>		
<p>Further Suggestions: None</p>		



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Programme/ Class: Diploma	Year: Second	Semester: Fourth
Subject: MICROBIOLOGY		
Course Code: B080402P	Course Title: Experiment in Molecular Biology and Microbial Genetics	
Course Outcomes:		Bloom's taxonomy
CO1- Understand the fundamentals of molecular biology and genetic research.		K1, K3
CO2- Use some basic equipment in a molecular biology laboratory.		K4, K5
CO3- Extract genomic DNA from microbes using molecular biology techniques		K2, K4
CO4- Measure DNA and verify purity using UV spectrometer and electrophoresis.		K3, K5
CO5- Understand the basic principle of plasmid isolation and their conformations using electrophoresis.		K1, K3
CO6- Understand the mutagenic effect of chemical and physical agents and perform test to identify mutagenic effect of chemicals		K3, K6
Credits: 2	Core: Compulsory	
Max. Marks: 25+75	Min. Passing marks: as per rules	
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P:0-0-2		
S. No.	Objectives	Total No. of Lectures/ Hours (60)
1	Isolation of genomic DNA from <i>E. coli</i> and analysis by agarose gel electrophoresis.	8
2	Estimation of DNA using diphenylamine reagent.	8
3	Resolution of proteins by polyacrylamide gel electrophoresis (SDS-PAGE) and visualization using coomassie dye.	10
4	Replica plating method: Preparation of master and replica plates. Isolation of Histidine auxotrophs	10
5	Isolation of plasmid DNA from <i>E. coli</i> . Study the different conformations of plasmid DNA through agarose gel electrophoresis	8
6	Study of the effect of chemical (nitrous acid) and physical (UV) mutagens on bacterial cells.	8
7	Demonstration of Ames test.	8



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

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Suggested readings:

Michael Wink, An Introduction to Molecular Biotechnology (2nd), 2012. ISBN: 9783527326372, TX Wiley-Blackwell.

Seidman & Moore, Basic Laboratory Methods for Biotechnology: Textbook & Laboratory Reference, 2nd edition. 2009. Prentice Hall. ISBN: 0321570146.

Sambrook J and Russell DW., Molecular Cloning: A Laboratory Manual. 4th Edition, 2004, Cold Spring Harbour Laboratory press.

Digital links:

<https://www.sciencedirect.com/topics/pharmacology-toxicology-and-pharmaceutical-science/ames-test>

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4846332/>

This course can be opted as an elective by the students of following subjects: Open for all

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Course prerequisites: To study this course, a student must have had the subject “Basic Biochemistry and Microbial Physiology” in III Semester of Diploma course in Microbial Technology.

Suggested Continuous Evaluation Methods

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Further Suggestions: None



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FACULTY OF SCIENCE

KHWAJA MOINUDDIN CHISTI LANGUAGE UNIVERSITY, LUCKNOW, U.P. (India)

B.Sc. - Microbiology (2nd Year, Semester-III or IV) Generic Elective-3 or 4 (GE-3/4)/Minor Elective-3 or 4

Minor Microbiology-3 or 4

Microbial ecology and Bio control by Microorganism Effective from Session 2022-23



ख्वाजा मुईनुद्दीन चिश्ती भाषा विश्वविद्यालय, लखनऊ, उत्तर प्रदेश (भारत)
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Programme/Class: Certificate	Year: Second	Semester: Third or Fourth
Subject: Microbiology		
Course Code: B080203T	Course Title: Microbial ecology and Bio control by Microorganism	
Course Outcomes:		Bloom's taxonomy
CO1- Get acquainted with natural habitats of diverse protection.		K1, K4
CO2- Understand how microbes interact among themselves and with higher plants and animals with the help of various examples.		K2, K4
CO3- Become aware of the important role microbes play in bio-geochemical cycling of essential elements occurring within an ecosystem and its significance.		K2, K5
CO4- Gain in depth knowledge of different types of solid waste, liquid waste and their management.		K3, K5
CO5- Get familiar with problems of pollution and applications of clean up technologies for the pollutants.		K3, K6
Credits: 4		GE-3 and 4/Minor Elective-3 and 4
Max. Marks: 25+75		Min. Passing marks: as per rules
Total No. of Lectures-Tutorials-Practical(in hours per week): L-T-P: 4-0-0		
Unit	Topics	Total No. of Lectures/ Units & Hours (60)
I	Interaction of Microorganisms Positive and negative interaction- Mutualism, Synergism, Commensalism, Competition, Amensalism, Parasitism, Predation, Microorganism of rhizosphere, rhizoplane and phylloplane, mycorrhiza (types and its applications).	15
II	Cycling of nutrients (Biogeochemical cycles) – Carbon cycle- Microbial degradation of cellulose, hemicellulase, lignin and chitin; Nitrogen cycle- Nitrogen fixation, ammonification, nitrification, denitrification and nitrate reduction, Phosphorous cycle- Phosphate Immobilisation and solubilisation and Sulphur cycle- Microbes involved in sulphur cycle.	15
III	Biodegradation and Bioremediation Types of bioremediation -microbial bioremediation, phytoremediation, and mycoremediation, Types of reaction in bioremediation, Factors affecting microbial bioremediation-Biotic or biological factors and Abiotic or environmental factors, Biodegradation of hydrocarbons, pesticides and herbicides	15
IV	Sewage/Waste Water Treatment Solid waste management: Source and type of solid waste, method of solid waste disposal (composting and sanitary landfill), Liquid waste management: composition and strength of sewage (BOD & COD), Preliminary treatment, Secondary (oxidation pond, trickling filter, activated sludge process and septic tank) or biological treatment, Waste water treatment of some industry, water recycling	15



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Suggested Readings: Alexander M., Introduction to soil microbiology, Wiley Eastern limited, New Delhi. Alexopoulos C.J. and MIMS C.W., Introductory Mycology, New age international, New Delhi. Aneja K.R., Experiments in Microbiology, plant pathology, Tissue culture and Mushroom cultivation, New Age International, New Delhi Hurst, C.J., Environmental Microbiology, ASM press, Washington D.C. Mehrotra A.S., Plant Pathology, Tata Mcgraw Hill Publications limited, New Delhi. Pelczar M.J., Chan E.C.S and Kreig N.R., Microbiology, Mcgraw-Hill Book Company, New York. Prescott Lansing M., Harley John P. and Klein Donald A., Microbiology, WCB Mcgraw- Hill, New York. Salle A.J., Fundamental Principles of Bacteriology, Tata Mcgraw-Hill Publishing Company Limited, New Delhi. Stacey R.H. and Evans H.J., Biological Nitrogen Fixation, Chapman and Hall limited, London. Stanier R.Y., Ingraham J.L., General Microbiology, Prentice Hall of India Private Limited, New Delhi. Subbarao N.S., Soil Microroganisms and Plant Growth, Oxford and IBH Publishing Company, New Delhi.		
This course can be opted as an elective by the students of following subjects: Open for all The eligibility for this paper is 10+2 with any subject		
Suggested Continuous Evaluation Methods: <input type="checkbox"/> Seminar/ Presentation on any topic of the above syllabus <input type="checkbox"/> Test with multiple choice questions/ short and long answer questions Attendance		
Course prerequisites: To study this course, a student must have had the subject ALL in class12th . The eligibility for this paper is 10+2 with any subject		
Further Suggestions: It widens the scope for students to join Government and Non-Government organization upskilling the people at different levels as per their socio-economic structure		
At the End of the whole syllabus any remarks/ suggestions:		