



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))

SDG 14: Life Below Water
Academic Alignment

S.No.	Department	Course (Degree)	Year/Semester	Course Name	SDG 14 Relevance
1.	Geography	B.A./B.Sc	2 nd Year/ III Sem	Oceanography	Scientific study of marine topography, currents, and ocean floor.
2.	Geography	M.A.	1 st Year/ I Sem	Oceanography	Advanced theoretical study of marine ecosystems and hydrology.
3.	Geography	M.A.	2 nd Year/ III Sem	Soil, Water and Air Analysis	Technical training in water quality monitoring and pollution detection.
4.	Geography	B.A./B.Sc	2 nd Year/ III Sem	Environment, Disaster Management & Climate Change	Focus on coastal disaster mitigation and the impact of climate change on water.
5.	Law	B.A.LL.B.	2 nd Year/ III Sem	Environmental Studies	Specific unit on Aquatic Ecosystems (oceans, estuaries, and rivers).
6.	Law	LL.B.	1 st Year/ I Sem	Law of Torts	Application of Nuisance and Strict Liability to prevent water pollution.
7.	Law	LL.M.	2 nd Year/ III Sem	Human Rights	Framework for recognizing Clean Environment and water as a human right.
8.	Civil Engineering	B.Tech	4 th Year/ VII Sem	Environmental Engineering-II	Design of advanced wastewater treatment and disposal systems.
9.	Civil Engineering	B.Tech	4 th Year/ VII Sem	Environmental Engineering Lab-II	Practical testing for BOD, COD, and Nitrogen to prevent eutrophication.

10.	Civil Engineering	B.Tech	3 rd Year/ VI Sem	Environmental Engineering Lab-I	Monitoring Dissolved Oxygen (DO) and turbidity in aquatic samples.
11.	Civil Engineering	B.Tech	2 nd Year/ IV Sem	Advance Surveying Lab	Use of GPS and Mapping for coastal and hydrological monitoring.
12.	Computer Science	M.Tech (AI/ML)	2 nd Year/ III Sem	Cluster Computing & Bioinformatics	HPC and analytical tools for genomic marine research and ocean modeling.
13.	Chemistry	B.Sc.	1 st Year/ I Sem	Quantitative Chemical Analysis	Laboratory methods for estimating water quality and chemical pollutants.
14.	Microbiology	B.Sc.	2 nd Year/ III Sem	Basic Biochemistry & Microbial Physiology	Study of microbial roles in aquatic ecosystems and bioremediation.



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**B.A (Geography)- Environment, Disaster Management and
Climate Change**

Programme/Class: Diploma/BA/B.Sc.	Year: Second	Semester: Third
Subject: Geography		
Course Code: A110301T	Course Title: Environment, Disaster Management and Climate Change	
Course outcomes: Students will be able to understand		
<ul style="list-style-type: none">• The course aim is to give basic understanding of concept Environment, Climate Change and Disaster Management.• Understanding of the concept of appraisal and conservation of Environment and Natural Resources.• It will help in developing understanding about various Impacts of Climate Change.• This course shall introduce the basic concepts related to disaster Management.• This paper shall help in understanding Global effort in field of disaster management.		
Credits: 6	Course Type-Core Course	
Max. Marks: 100 (30+70)	Min. Passing Marks:40	
Total No. of Lectures-Tutorials-Practical (in hours per week): L- 2 P-4/w		
Unit	Topics	No. of Lectures Total=90
I	Concepts & components of Environment, Ecology and ecosystem. Indian traditional Knowledge in Environment and disaster Management. Bio-diversity and its conservation, sustainable development.	23
II	Ganga Action Plan, Tiger project, Tehri dam & Narmada Valley project. Science of Climate Change: Understanding Climate Change; Green House Gases and Global Warming.	23
III	Global Climatic Assessment – IPCC, Impacts of Climate Change, National Action Plan on Climate Change.	22
IV	Disasters, Hazards, Risk, Vulnerability, Type of Disasters, Disaster Management, Disaster Management Cycle. Flood, Drought, Cyclone, Earthquake, Tsunami, Landslide, Chemical and Nuclear Disasters. Do's and Don'ts During Disasters.	22

Suggested Readings:

1. Casper J.K. (2010). *Changing Ecosystems: Effects of Global Warming*. New York, USA: InfobasePub.
2. Hudson, T. (2011). *Living with Earth: An Introduction to Environmental Geology*. Delhi, India: PHI Learning Private Limited.
3. Miller, G.T. (2007). *Living in the Environment: Principal, Connections, and Solutions*. Belmont, Australia: Brooks/ Cole Cengage Learning.
4. Singh, R.B. (1993) *Environmental Geography*. Delhi, India: Heritage Publishers.
5. UNEP. (2007). *Global Environment Outlook: GEO4: Environment For Development, United Nations Environment Programme*. UK: University Press, Cambridge.
6. Government of India. (2011). *Disaster Management in India*. Delhi, India: Ministry of Home Affairs.
7. Singh, Savendra (2019) *Pryavaran Bhugol*, Pravalika Publication, Allahabad
8. Kapur, A. (2010). *Vulnerable India: A Geographical Study of Disasters*. Delhi, India: Sage Publication.
9. Singh, Savendra (2019) *Apada Prabandhan*, Pravalika Publication, Allahabad.
10. Ramkumar, M. (2009). *Geological Hazards: Causes, Consequences and Methods of Containment*. New Delhi, India: New India Publishing Agency.
11. Climate Change: Understanding Climate Change; Green House Gases and Global Warming; Global Climatic Assessment-IPCC
12. Climate Change and Vulnerability: Physical Vulnerability; Economic Vulnerability; Social Vulnerability.
13. Impact of Climate Change: Agriculture and Water; Flora and Fauna; Human Health
14. Adaptation and Mitigation: Global Initiatives with Particular Reference to South Asia.
15. The Climate Change Policy Framework: Global Initiatives UNFCCC and COPs; National and Local Action Plan on Climate Change.
16. Government of India. (2008). *Vulnerability Atlas of India*. New Delhi, India: Building Materials & Technology Promotion Council, Ministry of Urban Development, Government of India
17. Modh, S. (2010). *Managing Natural Disaster: Hydrological, Marine and Geological Disasters*. Delhi, India: Macmillan.
18. Bansal SC, (2020) *Jalvayuvigyan evam Samudra Vigyan*, Meenakshi Publication, Meerut.
19. Bansal SC, (2019) *Prayavarn ek adhyan*, Meenakshi Publication, Meerut.

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

Suggested Continuous Evaluation Methods:

Assignment / test / Quiz (MCQ) / Seminar / Presentations



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B.A (Geography)- Oceanography

Programme/Class: B.A./B.Sc.	Year: II	Semester: III
Subject- Geography		
Course Code: A020302T	Course Title: Oceanography	
Course outcomes: <ul style="list-style-type: none">• Understand the elements of ocean and relief and its impacts at different scales.• Comprehend the oceanic aspects and its bearing on planet earth.• Understand the oceanic process and availability of resources.		
Credits: 6	Course Type-Core Course	
Max. Marks: 100 (30+70)	Min. Passing Marks:40	
Total No. of Lectures-Tutorials-Practical (in hours per week): L- 2 P-4/w		
Unit	Topics	No. of Lectures Total=90
I	Basic Oceanography; Surface Bottom Relief: Pacific Ocean, Atlantic Ocean & Indian Ocean.	23
II	Physical & Chemical Properties of Sea Water; Interlink Between Atmospheric Circulation & Circulation Patterns in the Oceans; Thermohaline, Waves & Tides	23
III	Ocean Current: Cause, Types, Currents of Pacific, Atlantic & Indian Ocean; Effects of Ocean Currents; El Nino La Nina & Southern Oscillation.	22
IV	Ocean Deposits: Types & Distribution; Coral Reefs & Atolls; Theories of their Formation & Coral Bleaching; Tsunami; Sea Level Changes: Causes, Evidence & Impact	22
Suggested Readings: <ol style="list-style-type: none">1. Davis Richard J.A.: "Oceanography - An Introduction to the Marine Environment" Wm. C. Brown Low a. 1986.2. Duxbury "C.A. and Duxbury B.: An Introduction to the World's Oceans. C. Brown Low a 2nd ed. 1996.3. Garrison, T.: "Oceanography - An Introduction to Marine Science. Books/ Cole, Pacific Grove, USA, 2001.4. Gross, M. Grant: Oceanography, A View of the Earth, Prentice Hall Inc. New Jersey, 1987.5. King, C.A.M. Oceanography for Geographers, 1962.6. Sharma, R.C. "The Oceans" Rajesh N. Delhi, 1985.7. Singh, R.B. Natural Hazards and Disaster Management, Raw at Publication, Jaipur, 20068. Ummerkuty, A.N.P. Science of the Oceans and Human Life, NBT, New Delhi, 1985.		



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M.A (Geography)- Oceanography

Programme/Class: Bachelor (Research in Faculty)/ or M.A./M.Sc. (1 st Semester)	Year: IV	Semester: VII M.A./M.Sc. (1 st Semester)
Subject- Geography		
Course Code: GRB CC 702T	Course Title: Oceanography	
Course Outcomes: <ul style="list-style-type: none">• Understand the elements of ocean and relief and its impacts at different scales.• Comprehend the oceanic aspects and its bearing on planet earth.• Understand the oceanic process and availability of resources.		
Credits: 4	Course Type-Core Course	
Max. Marks: 100 (25+75)	Min. Passing Marks:40	
Total No. of Lectures-Tutorials-Practical (in hours per week): L- 04/w		
Unit	Topics	No. of Lectures Total=60
I	Basic Oceanography; Surface Bottom Relief: Pacific Ocean, Atlantic Ocean & Indian Ocean.	15
II	Physical & Chemical Properties of Sea Water; Interlink Between Atmospheric Circulation & Circulation Pattern in the Oceans; Thermohaline, Waves & Tides	15
III	Ocean Current: Cause, Types, Currents of Pacific, Atlantic & Indian Ocean; Effects of Ocean Currents; El Nino La Nina & Southern Oscillation.	15
IV	Ocean Deposits: Types & Distribution; Coral Reefs & Atolls; Theories of their Formation & Coral Bleaching; Tsunami; Sea Level Changes: Causes, Evidence & Impact	15

Suggested Readings:

Davis Richard J.A.: "Oceanography - An Introduction to the Marine Environment" Wm. C. Brown Low a. 1986.

Duxbury C.A. and Duxbury B.: An Introduction to the World's Oceans. C. Brown Low a 2nd ed. 1996.

Garrison, T.: "Oceanography – An Introduction to Marine Science. Books/ Cole, Pacific Grove, USA, 2001.

4. Gross, M. Grant: Oceanography, A View of the Earth, Prentice Hall Inc. New Jersey, 1987.

5. King, C.A.M. Oceanography for Geographers, 1962.

6. Sharma, R.C. "The Oceans" Rajesh N. Delhi, 1985.

7. Singh, R.B. Natural Hazards and Disaster Management, Raw at Publication, Jaipur, 2006

8. Ummerkutty, A.N.P. Science of the Oceans and Human Life, NBT, New Delhi, 1985.

Programme/Class: M.A./M.Sc.	Year: II	Semester: III
Subject- Geography		
Course Code: GRM 304 A	Course Title: Practical Remote Sensing and GIS; Soil, Water and Air Analysis	
<p>Course outcomes:</p> <ul style="list-style-type: none"> • To develop an understanding of remote sensing and GIS technologies and their potential applications • Students will demonstrate their knowledge of physical geography and the methods and techniques for observing, measuring, recording and reporting on geographic phenomena. • Students will demonstrate their competence to work individually and as a team to develop and present a client-driven GIS solution. • Student will be familiar with modern techniques in Geography. • Students will be prepared to apply their skills in professional careers. 		
Credit:4	Course Type - Core Course	
Max. Marks: 100(30+70)	Total No. of Lectures-60	
Unit	Topics	No. of Lectures (Hours) per week=04
I	Stereoscopic test; Interpretation of stereograms and stereopairs; Mapping for land use/ land cover; Determination of photoscale; Border information on Landsat/ IRS Images.	
II	Soil analysis: texture and structure;	
III	Water analysis: physical and chemical characteristics;	
IV	Air analysis: estimation of SPM.	
V	Visual interpretation of satellite images (Landsat/ IRS); Scanning, digitisation and editing; Base map preparation.	

Suggested Readings:

1. Cracknell, A. and Ladson, H (1990): Remote Sensing Year Book. Taylor and Francis, London.
2. Curran, P.J. (1988): Principles of Remote Sensing. ELBS Longman, Essex, U.K.
3. Deekshatulu, B.L. and Rajan, Y.S. (ed.) (1984): Remote Sensing. Indian Academy of Science, Bangalore.
4. Floyd, F. S. Jr. (1997): Remote Sensing: Principles and Interpretation. W.H. Freeman, New York.
5. Hallert, B. (1960): Photogrammetry. McGraw Hill Book Company. Inc. New York
6. Leuder, D.R. (1959): Aerial Photographic Interpretation: Principles and Application, McGraw Hill, New York.
7. Lillesand, T.M. and Kiefer, R.W. (2000): Remote Sensing and Image Interpretation. 4th ed. John Wiley and Sons, New York.
8. Rampal, K.K. (1999): Handbook of Aerial Photography and Interpretation. Concept Publishing. Company, New Delhi.
9. Reeves, R.G. (ed.) (1983): Manual of Remote Sensing. Vols. 1 and 2, American Society of Photogrammetry and Remote Sensing, Falls Church, Virginia.
10. Siegel, B.S. and Gillespie, R. (1985): Remote Sensing in Geology. John Wiley and Sons, New York.
11. Spurr, R. (1960): Photogrammetry and Photo Interpretation. The Roland Press Company, London.
12. Survey of India, (1973): Photogrammetry. Survey of India, Dehradun.
13. Swain, P.H. and Davis, S.M. (ed.) (1978): Remote Sensing: The Quantitative Approach. McGraw- Hill, New York.
14. Wolf P.R. and Dewitt, B. A. (2000): Elements of Photogrammetry with Applications in GIS. McGraw-Hill, New York.

B.A.LL.B- Environmental Studies



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B.A. LL.B. - A DOUBLE DEGREE INTEGRATED COURSE

IVth Semester

Paper: Core

Paper Code: BALLB403

Credit: 4

Marks 30 Internal + 70 End Semester

Paper III

Environmental Studies

Unit 1: The multidisciplinary nature of Environmental Studies,
Definition, Scope and Importance. Need for awareness.

(Lectures-10)

Unit 2: Natural Resources

(Lectures-15)

Renewable and Non-renewable Resources

Natural resources and associated problems

a) Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction mining, dams and their effects on forests and tribal people.

Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dam's benefits and problems.

c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.

d) Food resources: World food problem changes caused by agriculture and overgrazing, modern agriculture, fertilizer- pesticide problems, water logging, salinity, case studies. Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of, effects of alternate energy sources, case studies.

Land resources: Land as resource, land degradation, man induced landslides, soil erosion and desertification

Role of an individual in conservation of natural resources.

Equitable use of resources for sustainable lifestyles.

Unit 3: Ecosystems

(Lectures-12)

Concept of an ecosystem. . Structure and function of an ecosystem. Producers, consumers and decomposers.

Energy flow in the ecosystem Ecological succession. Food chains, food webs and ecological pyramids.

Introduction, types, characteristic features, structure and function of the following ecosystem (a) Forest ecosystem,

(b) Grassland Ecosystem. (c) Desert Ecosystem, (d) Aquatic Ecosystem (ponds, stream, lakes, rivers, oceans, estuaries)

Unit 4: Biodiversity and its Conservation

(Lectures-12)

Introduction-Definition, Genetic, species and ecosystem diversity. Bio-geographical classification of India. Value

of biodiversity consumptive use, productive use, social, ethical, aesthetic and option values, biodiversity at global.

National and local levels. India as a mega diversity nation, Hot-spots of biodiversity. Threats to biodiversity: habitat

loss, poaching of wildlife, man-wildlife conflicts. Endangered and endemic species of India, Conservation of

biodiversity: In-situ, Ex-situ conservation of biodiversity.

Prof. C.P. Singh

Prof. Manish Singh

Dr. Amit Singh

Prof. Masood Alam



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LL.B.(Three years course) (First Year) 1st Semester

Paper: Core Paper Code: LLB103

Credit: 4 Marks 30 Internal + 70 End Semester

Paper III
Law of Tort-I

The course outcome is

1. To develop the understanding of Tort and civil wrong;
2. To expose the students about the basic principles of law of tort;
3. To apprise the students about wrong and remedies for the same

Unit-I: Introduction and Principle in Tort

(Lecture-12)

Nature & Definition of Tort, Development of Tort, Tort distinguished from Contract, Crime and Breach of Trust, Cyber tort

Unit-II: General Condition of Liability in Tort

(Lecture-12)

Wrongful Act, Legal Damage, Damnum sine Injuria, Injuria sine Damnum, Legal Remedy-Ubi jus ibi remedium, Mental Element in Tort, Motive, Intention, Malice and its Kinds, Malfeasance, Misfeasance and non-feasance, Fault whether essential

Unit III: Justification of Tort

(Lecture-12)

Volenti non fit injuria, Act of God, Inevitable accidents, Plaintiff's default, Private defence, Judicial and Quasi-Judicial Act, Parental and Quasi-Parental authority, Acts causing slight harm

Unit-IV: Remedies and Damages

(Lecture-12)

Personal Capacity, Who can not sue, Who can not be sued, General Remedies in Tort, Damages and its kinds Remoteness of Damage (In Re Prolemis & Wagon Mount Case) Judicial and Extra Judicial Remedies Joint Tort feasons Vicarious Liability

Books

1. Salmond & Heuston-On the Law of Torts (2000), Universal, Delhi
2. D.D.Basu, The Law of Torts (1982) Kamal, Calcutta.
3. Winfield & Jolowiz on Tort (1999) Sweet and Maxwell, London
4. Ratan Lal & Dhiraj Law-The Law of Torts (1997) Universal, Delhi
5. R.K.Bangia, Law of Torts

Prof. C.P. Singh

Prof. Manish Singh

Dr. Amit Singh

Prof. Masood Alam



LL.M.- Human Rights

Master of Laws LL.M.

Semester – III

Paper: Core

Course Code: LLM CC-301

Credit- 4 Marks: 30 Internal + 70 End Sem

Course Title: Human Rights

Course Outcomes:

C.O. 1 : Human Rights

C.O. 2 : human rights protection scheme

C.O. 3 : Human Rights Protection in International Order

Program Outcomes

To inculcate the value of protection of Human Rights.

Unit I : Panoramic View of Human Rights(12 Lectures)

1.1 Human Rights in Non-Western Thought, Awareness of Human Rights during the nationalist movement, Universal Declaration of Human Rights, Constituent Assembly and Part III, drafting process,

1.2 Subsequent developments in International Law and the Position in India (e.g., Convention of Social Discrimination, Torture, Gender discrimination, Environment and the Two human right covenants.)

1.3 Fundamental Rights Jurisprudence as Incorporating Directive Principles The dichotomy of Fundamental Rights and Directive Principles, The interaction between Fundamental Right and Directive Principles, Resultant expansion of basic needs oriented human rights in India.

Unit II : Right not be Subject to Torture, Inhuman or Cruel Treatment (12 Lectures)

2.1 Conceptions of torture, third-degree methods, 'Justification' for it, Outlay of torture at international and constitutional law level, Incidence of torture in India, Judicial attitudes, Law Reform- proposed and pending. Minority Rights : Conception of minorities, Scope of protection, The position of minority 'Woman' and their basic rights, Communal Riots as involving violation of rights.

Unit III (12 Lectures)

Rights to Development of Individuals and Nations : The U.N. Declaration on right to Development, 1987, The need for constitutional and legal changes in India from human rights standpoint. People's Participation in Protection and Promotion of Human Rights : Role of International NGOS, Amnesty International, Minority Rights Groups, International Bars Association, Law Asia, Contribution of these groups to protection and promotion of human rights in India.



B.Tech (Civil Engineering)- Environmental Engineering-II

ENVIRONMENTAL ENGINEERING-II

SUBJECT CODE: CE 701

L-T-P: 3-1-0

Credit: 4

COURSE OBJECTIVES

1. To impart the basic knowledge, skills and attitudes of beneficial uses of water, quality requirements and standards; of water and wastewater treatment, unit operation
2. To various concepts of sedimentation, coagulation, flocculation and primary, secondary and tertiary treatment processes; of anaerobic digestion

COURSE OUTCOMES

After studying this course, students will be able to:

- CO-1 Understand the operation and design of treatment units of water treatment plants.
- CO-2 An understanding of the operation and design of primary treatment units of wastewater treatment systems.
- CO-3 An understanding of the operation and design of secondary treatment units of wastewater treatment systems.
- CO-4 Know the Sources and characteristics of Sludge Thickening, Sludge digestion
- CO-5 Know the Waste Water Disposal Methods



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B. Tech (Civil Engineering)- Environmental Engineering Lab

SUBJECT CODE: CE – 751

1. Determination of total suspended solids.
2. Determination of BOD of sample.
3. Determination of COD of sample.
4. Determination of Kjeldahl nitrogen.
5. Determination of fluorides.
6. Determination of rate kinetics constant of aerobic reactions
7. Filed visit of water / wastewater treatment plant.



B. Tech (Civil Engineering) 3rd Year- Environmental Engineering II

ENVIRONMENTAL ENGINEERING LAB -I
SUBJECT CODE: CE- 651

L-T-P: 0-0-2

Credit: 1

1. Determination of turbidity, color and conductivity.
2. Determination of pH, Alkalinity, and acidity.
3. Determination of hardness and chlorides
4. Determination of residual chlorine and chlorine demand
5. Determination of dissolved oxygen
6. Determination of most probable number of coliforms.



M.Tech- Cluster Computing & Bioinformatics

MEAM-43:CLUSTER COMPUTING

Course Outcome (CO) :	
CO 1:	Understand the fundamental principles of distributed computing.
CO 2:	Understand the concept of cluster computing
CO 3:	Understand the importance of Cluster Technology
CO 4:	To Introduce the student to analytical tools and methods, which are currently used in bioinformatics as applied to biological information for human beings.
CO 5:	To Introduce the student to System Infrastructure
Unit	Topic
I	Basic concepts in Distributed Systems: Notion of time Distributed Mutual exclusion, Consensus, Failure models Paradigms for process interaction in distributed programs, Programming Paradigms, Shared memory, Message passing, Workflows.
II	Introduction to Cluster Computing, Cluster Middleware: An Introduction, Early Cluster Architecture and High Throughput Computing Clusters, Networking, Protocols and I/O for Clusters, Setting Up and Administering a Cluster.
III	Cluster Technology for High Availability, Performance Models and Simulation, Process Scheduling, Load Sharing and Load Balancing, Distributed Shared Memory.
IV	Introduction to Grid Architecture, Characterization of Grid, and Grid related standard bodies, Grid types, Topologies, Components and Layers, Comparison with other approaches.
V	System Infrastructure, Traditional paradigms for distributed computing, Web Services, Grid standards: OGSA and WSRF, Case Studies of Cluster Systems: Beowulf, COMPaS, NanOS and PARAM.

Text Book (s):

1. High Performance Cluster Computing: Architectures and Systems, Prentice Hall.
2. Grid and Cluster Computing, Prabhu C.S.R, PHI Learning Private Limited.



B. Sc (Chemistry)- Quantitative Analysis

Programme/Class: Certificate	Year: First	Semester: First
Subject: Chemistry		
Course Code: B020102P	Course Title: Quantitative Analysis	
Course Outcomes: The student at the completion of the course will be able to: <ul style="list-style-type: none"> • Upon completion of this course the students will have the knowledge and skills to: understand the laboratory methods and tests related to estimation of metals ions and estimation of acids and alkali contents in commercial products. • · Potability tests of water samples. • · Estimation of metal ions in samples · Estimation of alkali and acid contents in samples · Estimation of inorganic salts and hydrated water in sample 		
Credits: 2	Core: Elective	
Max. Marks: 25+75	Min. Passing marks: as per rules	
Total No. of Lectures-Tutorials-Practical(in labs per week): L-T-P: 0-0-2		
S. No.	Objectives Any 3 practicals from each unit may be performed/demonstrated	Total No. of Lectures/ Hours (60)
1.	Water Quality analysis <ul style="list-style-type: none"> • 1. Estimation of hardness of water by EDTA. • 2. Determination of chemical oxygen demand (COD). • 3. Determination of Biological oxygen demand (BOD) 	16
2.	Estimation of Metals ions <ul style="list-style-type: none"> • 1. Estimation of ferrous and ferric by dichromate method. • 2. Estimation of copper using thiosulphate. 	14
3.	Estimation of acids and alkali contents <ul style="list-style-type: none"> • 1. Determination of acetic acid in commercial vinegar using NaOH. • 2. Determination of alkali content – antacid tablet using HCl. • 3. Estimation of oxalic acid by titrating it with K 	14

4.	Estimation of inorganic salts and hydrated water <ul style="list-style-type: none"> ● 1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture. ● 2. Estimation of calcium content in chalk as calcium oxalate by permanganometry. ● 3. Estimation of water of crystallization in Mohr's salt by tit 	16
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Suggested Readings:

- 1. Mendham, J. Vogel's Quantitative Chemical Analysis, Pearson, 2009.
- 2. Harris, D. C. Quantitative Chemical Analysis. 6th Ed., Freeman (2007) Chapters 3-5.
- 3. Harris, D.C. Exploring Chemical Analysis, 9th Ed. New York, W.H. Freeman, 2016.
- 4. Khopkar, S.M. Basic Concepts of Analytical Chemistry. New Age International Publisher, 2009.
- 5. Skoog, D.A. Holler F.J. and Nieman, T.A. Principles of Instrumental Analysis, Cengage Learning India Edition Note: For the promotion of Hindi language, course books published in Hindi may be prescribed by the University Suggestive digital platforms web links
- 6. <https://www.labster.com/chemistry-virtual-labs/>
- 7. <https://www.vlab.co.in/broad-area-chemical-sciences>
- 8. <http://chemcollective.org/vlab>

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 biology in class 12th

Suggested Continuous Evaluation Methods:

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Further Suggestions: None



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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))

B.Sc. (Microbiology)- Basic Biochemistry & Microbial Physiology

Programme/Class: Diploma	Year: Second	Semester: Third
Subject: MICROBIOLOGY		
Course Code: B080301T	Course Title: Basic Biochemistry and Microbial Physiology	
Course Outcomes:		Bloom's Taxonomy
<ul style="list-style-type: none"> • CO1- Will have understanding of the basic principles of thermodynamics applied to biological systems 		K1, K3
<ul style="list-style-type: none"> • CO2- Will be conversant with the structures of carbohydrates, lipids, proteins and nucleic acids 		K2, K4
<ul style="list-style-type: none"> • 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
<ul style="list-style-type: none"> • CO4- Will be acquainted with the diverse physiological groups of bacteria/archaea and microbial transportsystems. 		K3, K6
<ul style="list-style-type: none"> • 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
<ul style="list-style-type: none"> • 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
<ul style="list-style-type: none"> • 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)- Chemiosmotic hypothesis, oxidative phosphorylation and ATP generation, Gluconeogenesis	12

III	<p>Proteins</p> <p>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</p>	6
IV	<p>Lipids & Nucleic acids</p> <p>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.</p>	6
V	<p>Enzymology concepts:</p> <p>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</p>	6
VI	<p>Microbial nutrient uptake and transport:</p> <p>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</p>	8
VII	<p>Microbial growth and effect of environmental factors on growth</p> <p>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</p>	8
VIII	<p>Stress physiology and Nitrogen metabolism</p> <p>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</p>	8

Suggested Readings:

1. Moat A.G., Foster J.W. and Spector M.P. 2002. *Microbial Physiology*, 4th edition. A Johan Wiley and sons inc., publication.
2. Kim B.H. and Gadd G.M. 2008. *Bacterial physiology and metabolism*. Cambridge University Press, Cambridge.
3. Gilbert H.F. 2000. *Basic concepts in biochemistry: A student's survival guide*. Second Edition. Mc-Graw-Hill Companies, health professions Division, New York.
4. Madigan M.T., Martinko J.M., Stahl D.A. and Calrk D.P. 2012. *Brock Biology of Microorganisms*. 13th ed. Pearson Education Inc.
5. Jeremy M. Berg, John L. Tymoczko, Gregory J. Gatto Jr., Lubert Stryer.2015. *Biochemistry* 8th edition. W. H. Freeman.
6. 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