Annexure-I

CHM

Session: 2024-25			
PartA - Introduction			
Name of the Programme	Common to all PG Programmes		
Semester	2nd		
Name of the Course	Constitutional, Human andMoral Values, and IPR		
Course Code	M24-CHM-201		
CourseType	CHM		
Level of the course	400-499		
Pre-requisite for the course (ifany)	-		
CourseLearningOutcomes (CLO) After completing this course, the learner will be able to:	CLO-1: Learn the different Constitutional Values, Fundamental rights and duties enshrined in the India Constitution. CLO-2: Understand humanism, human virtues and values, and ide of International peace. CLO-3: Grasp the basic conceptsof Moral Values and Professional Conduct which are required to become a part of the civil society and for developing professionalism. CLO-4:Understandconcepts of Intellectual Property Rights,Copyright, Patent, Trademark etc., andabout threats of Plagiarism.		
Credits	Theory	Practical	Total
	2	0	2
Teaching Hours per week	2	0	2
Internal Assessment Marks	15	0	15
End Term Exam Marks	35	0	35
Max. Marks	50	0	50
Examination Time	3 hours		
PartB-Contentsofthe Course			
Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unitand the compulsory question. All questions will carry equal marks.			

49(1111)

Unit	Topics	Contact Hours
I	**Constitutional Values:** Historical Perspective of Indian Constitution; Basic Values enshrined in the Preamble of the Indian Constitution; Concept of Constitutional Morality; Patriotic Values and Ingredients Nation Building; Fundamental Rights and Duties ; Directive Principles of the State Policy.	8
II	**Humanistic Values:** Humanism, Human Virtues and Civic Sense; Social Responsibilities of Human Beings; Ethical ways to deal with human aspirations; Harmony with society and nature; Idea of International Peace and Brotherhood (VasudhaivKutumbkam).	7
III	**Moral Values and Professional Conduct** Understanding Morality and Moral Values; Moral Education and Character Building; Ethics of Relations: Personal, Social and Professional; Introduction to Gender Sensitization; Affirmative approach towards Weaker Sections (SCs, STs, OBCs, EWS& DAs); Ethical Conduct in Higher Education Institutions; Professional Ethics.	8
IV	**Intellectual Property Rights:** Meaning, Origins and Nature of Intellectual Property Rights (IPRs);Different Kinds of IPRs – Copyright, Patent, Trademark, Trade Secret/Dress, Design, Traditional Knowledge; Infringement and Offences of IPRs – Remedies and Penalties; Basics ofPlagiarism policy of UGC.	7
	Note: Scope of the syllabus shall be restricted to generic and introductory level of mentioned topics.	
	Total Contact Hours	30

SuggestedEvaluationMethods			
InternalAssessment: 15		**End Term Examination: 35**	
➢ **Theory**	**15**	➢ **Theory**	**35**
• Class Participation:	4	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	4		
• Mid-Term Exam:	7		

PartC-Learning Resources

Recommended Books/e-resources/LMS:

Ahuja, V K. (2017). *Law relating to Intellectual Property Rights*, India, IN: Lexis Nexis.

Bajpai, B. L., *Indian Ethos and Modern Management*, New Royal Book Co., Lucknow, 2004.

Basu, D.D., *Introduction to the Constitution of India* (Students Edition) Prentice Hall of India Pvt. Ltd., New Delhi, 20th ed., 2008.

Dhar, P.L. & R.R. Gaur, *Science and Humanism*, Commonwealth Publishers, New Delhi, 1990.

George, Sussan, *How the Other Half Dies*, Penguin Press, 1976.

Govindarajan, M., S. Natarajan, V.S. Sendilkumar (eds.), *Engineering Ethics (Including Human*

1112

Values), Prentice Hall of India Private Ltd, New Delhi, 2004.
Harries, Charles E., Michael S. Pritchard & Michael J. Robins, *Engineering Ethics*, Thompson Asia, New Delhi, 2003.
Illich, Ivan, *Energy & Equity*, Trinity Press, Worcester, 1974.
Meadows, Donella H., Dennis L. Meadows, Jorgen Randers & William W. Behrens, *Limits to Growth: Club of Rome's Report*, Universe Books, 1972.
Myneni, S.R, Law of Intellectual Property, Asian Law House.
Narayanan, P, *IPRs*.
Neeraj, P., &Khusdeep, D. (2014). *Intellectual Property Rights*, India, IN: PHI learning Private Limited.
Nithyananda, K V. (2019). *Intellectual Property Rights: Protectionand Management*. India, IN: Cengage Learning India PrivateLimited.
Palekar, Subhas, *How to practice Natural Farming*, Pracheen (Vaidik) KrishiTantraShodh, Amravati, 2000.
Phaneesh, K.R., *Constitution of India and Professional Ethics*, New Delhi.
Pylee, M.V., *An Introduction to Constitution of India*, Vikas Publishing, New Delhi, 2002.
Raman, B.S., *Constitution of India,* New Delhi, 2002.
Reddy, B., Intellectual Property Rights and the Law, Gogia Law Agency.
Reddy, N.H., SantoshAjmera, *Ethics, Integrity and Aptitude*, McGraw Hill, New Delhi.
Sharma, Brij Kishore, *Introduction to the Constitution of India,* New Delhi,
Schumacher, E.F., *Small is Beautiful: A Study of Economics as if People Mattered*, Blond & Briggs, Britain, 1973.
Singles, Shubham et. al., *Constitution of India and Professional Ethics,* Cengage Learning India Pvt. Ltd., Latest Edition, New Delhi, 2018.
Tripathy, A.N., *Human Values*, New Age International Publishers, New Delhi, 2003.
Wadehra, B.L., Law relating to Intellectual Property, Universal Law Publishing Co.

Relevant Websites, Movies and Documentaries:

Value Education Websites, http://uhv.ac.in, http://www.uptu.ac.in.
Story of Stuff, http://www.storyofstuff.com
Cell for IPR Promotion and Management: http://cipam.gov.in/.
World Intellectual Property Organization: https://www.wipo.int/about-ip/en/
Office of the Controller General of Patents, Designs & Trademarks: http://www.ipindia.nic.in/
Al Gore, *An Inconvenient Truth*, Paramount Classics, USA.
Charlie Chaplin, *Modern Times*, United Artists, USA.
Modern Technology – The Untold Story, IIT, Delhi.
A. Gandhi, *Right Here Right Now*, Cyclewala Productions.

1113

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Scheme of Examination
for
Post Graduate Programme

M. Sc. Environmental Science

as per NEP 2020
Curriculum and Credit Framework for Postgraduate Programme

With Multiple Entry-Exit, Internship and CBCS-LOCF
With effect from the session 2024-25 (in phased manner)

INSTITUTE OF ENVIRONMENTAL STUDIES
FACULTY OF LIFE SCIENCE

KURUKSHETRA UNIVERSITY, KURUKSHETRA -136119

HARYANA, INDIA

Director
Institute of Environmental Studies
Kurukshetra University
Kurukshetra-136119

49(1114)

Programme Learning Outcomes(PLOs) for PG Programmes as per NEP-2020

PLOs for a Master Degree in Environmental Science

PLOs	Master Degree in Environmental Science
	After the completion of Master degree in Environmental Science the student will be able to:
PLO-1: Knowledge and Understanding	Demonstrate the fundamental and advanced knowledge of the subjectand understanding of recent developments and issues, including methods and techniques, related to the **Environmental Science**.
PLO-2: General Skills	Acquire thegeneral skills required for performing and accomplishing the tasks as expected to be done by a skilled professional in the fields of **Environmental Science**.
PLO-3: Technical/ Professional Skills	Demonstrate the learning of advanced cognitive technical/professional skills required for completing the specialized tasks related to the profession and for conducting and analyzing the relevant research tasks indifferent domains of the **Environmental Science**.
PLO-4: Communication Skills	Effectively communicate the attained skills of the **Environmental Science** in well-structured and productive mannerto the society at large.
PLO-5: Application of Knowledge and Skills	Apply the acquired knowledge and skills to the problems in the subject area, and to identify and analyze the issues where the attained knowledge and skills can be applied by carrying out research investigations to formulate evidence-based solutions to complex and unpredictable problems associated with the field of **Environmental Science** or otherwise.
PLO-6: Critical thinking and Research Aptitude	Attain the capability of critical thinking in intra/inter-disciplinary areas of the **Environmental Science** enabling to formulate, synthesize, and articulate issues for designing of research proposals, testing hypotheses, and drawing inferences based on the analysis.
PLO-7: Constitutional, Humanistic, Moral Values and Ethics	Know constitutional, humanistic, moral and ethical values, and intellectual property rights to become a scholar/professional with ingrained values in expanding knowledge for the society, and toavoid unethical practices such as fabrication, falsification or misrepresentation of data or committing plagiarism.
PLO-8: Capabilities/qualities and mindset	To exercise personal responsibility for the outputs of own work as well as of group/team and for managing complex and challenging work(s)that requires new/strategic approaches.
PLO-9: Employability and job-ready skills	Attain the knowledge and skills required for increasing employment potential, adapting to the future work and responding to the rapidly changing demands of the employers/industry/society with time.

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Scheme of Examination for Postgraduate Programme Environmental Science
as per NEP 2020 Curriculum and Credit Framework for Postgraduate Programmes
(CBCS LOCF) with effect from the session 2024-25 (in phased manner)
Framework-2
Scheme-P

Semester	Course Type	Course Code	Nomenclature of course	Theory (T)/ Practical (P)	Credits		Contact hours per week L: Lecture P: Practical T: Tutorial				Internal Assessment Marks	End Term Examination Marks	Total Marks	Examination hours
						Total	L	T	P	Total				
1	CC-1	M24-EVS-101	Biophysical Environment	T	4	26	4	0	0	4	30	70	100	3
	CC-2	M24-EVS-102	Environmental and Green Chemistry	T	4		4	0	0	4	30	70	100	3
	CC-3	M24-EVS-103	Ecology and Ecosystem Dynamics	T	4		4	0	0	4	30	70	100	3
	CC-4	M24-EVS-104	Environmental Modeling and Statistics	T	4		4	0	0	4	30	70	100	3
	PC-1	M24-EVS-105	Practical-I	P	4		0	0	8	8	30	70	100	4
	PC-2	M24-EVS-106	Practical-II	P	4		0	0	8	8	30	70	100	4
	SEMINAR	M24-EVS-107	Seminar	S	2		0	0	0	2	0	50	50	1
2	CC-5	M24-EVS-201	Natural Resource Management	T	4	26	4	0	0	4	30	70	100	3
	CC-6	M24-EVS-202	Conservation and Biodiversity	T	4		4	0	0	4	30	70	100	3

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1116

	CC-7	M24-EVS-203	Environmental Pollution	T	4		4	0	0	4	30	70	100	3
	CC-8	M24-EVS-204	Environmental Methods and Analytical Techniques	T	4		4	0	0	4	30	70	100	3
	PC-3	M24-EVS-205	Practical-III	P	4		0	0	8	8	30	70	100	4
	PC-4	M24-EVS-206	Practical-IV	P	4		0	0	8	8	30	70	100	4
	CHM	M24-CHM-201	Constitutional, Human and Moral Values, and IPR	T	2		2	0	0	2	15	35	50	3
	Internship	M24-INT-200	An internship course of 4 Credits of 4-6 weeks duration during summer vacation after IInd semester is to be completed by every student. Internship can be either for enhancing the employability or for developing the research aptitude.								50	50	100	
3	CC-9	M24-EVS-301	Environmental Biotechnology and applications	T	4	26	4	0	0	4	30	70	100	3
	CC-10	M24-EVS-302	Remote Sensing and Geographical Information Systems	T	4		4	0	0	4	30	70	100	3
	DEC-1	M24-EVS-303	Ecotoxicology and Environmental Health	T	4		4	0	0	4	30	70	100	3
		M24-EVS-304	Environmental Planning , Policy and Law	T	4		4	0	0	4	30	70	100	3
		M24-EVS-305	Climatology and Global Climate Change	T	4		4	0	0	4	30	70	100	3
		M24-EVS-306	SWAYAM or other approved online portal	T	4		4	0	0	4	30	70	100	3
	DEC-2	M24-EVS-307	Industrial Ecology	T	4		4	0	0	4	30	70	100	3

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1117

		M24-EVS-308	Waste Management and Regulation	T	4		4	0	0	4	30	70	100	3
		M24-EVS-309	Industrial Water and Wastewater Treatment	T	4		4	0	0	4	30	70	100	3
		M24-EVS-310	SWAYAM or other approved online portal	T	4		4	0	0	4	30	70	100	3
	PC-5	M24-EVS-311	Practical-V	P	4		0	0	8	8	30	70	100	4
	PC-6	M24-EVS-312	Practical-VI	P	4		0	0	8	8	30	70	100	4
	OEC	M24-OEC-324	Global Climate Change	T	2		2	0	0	2	15	35	50	3
4	CC-11	M24-EVS-401	Agroecology and Agroforestry	T	4	26	4	0	0	4	30	70	100	3
	CC-12	M24-EVS-402	Environmental Impact Assessment and Auditing	T	4		4	0	0	4	30	70	100	3
	DEC-3	M24-EVS-403	Ecotechnology and Ecological Restoration	T	4		4	0	0	4	30	70	100	3
		M24-EVS-404	Ecological Economics	T	4		4	0	0	4	30	70	100	3
		M24-EVS-405	Environmental Health and Industrial Safety	T	4		4	0	0	4	30	70	100	3
		M24-EVS-406	SWAYAM or other approved online portal	T	4		4	0	0	4	30	70	100	3
	DEC-4	M24-EVS-407	Environmental Disasters Management	T	4		4	0	0	4	30	70	100	3
		M24-EVS-408	Energy Resources and Environment	T	4		4	0	0	4	30	70	100	3

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1118

		M24-EVS-409	Water Resource Management	T	4	4	0	0	4	30	70	100	3
		M24-EVS-410	SWAYAM or other approved online portal	T	4	4	0	0	4	30	70	100	3
	PC-7	M24-EVS-411	Practical-VII	P	4	0	0	8	8	30	70	100	4
	PC-8	M24-EVS-412	Practical-VIII	P	4	0	0	8	8	30	70	100	4
	EEC	M24-EVS-413	Environment, Energy and Safety Audit	T	2	2	0	0	2	15	35	50	3
OR													
If a candidate offered dissertation course in Semester-IV, then s/he will also study CC-12, DEC-3, DEC-4 and EEC from above courses of Semester-IV													
	Dissertation	M24-EVS-414	Dissertation	D	12	0	0	0	-	0	300	300	-
Total Credits= 26													

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1119

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Syllabus of the Programme
for
Post Graduate Programme
in
M. Sc. Environmental Science

as per NEP 2020
Curriculum and Credit Framework for Postgraduate Programme

With Multiple Entry-Exit, Internship and CBCS-LOCF
With effect from the session 2024-25 (in phased manner)

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FACULTY OF LIFE SCIENCE

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HARYANA, INDIA

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Kurukshetra University
Kurukshetra-136119

1120

Core Course (CC-1)

Session: 2024-25			
PartA - Introduction			
Name of Programme	M.Sc. Environmental Science		
Semester	Ist semester		
Name of the Course	Biophysical Environment		
Course Code	M24-EVS-101		
Course Type	CC-1		
Level of the course	400-499		
Pre-requisite for the course (if any)	Nil		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: Have in-depth knowledge of the process of origination of earth with help of various theories. CLO 2: Acquire knowledge about rocks faults, weathering and volcanism. CLO 3: Gather information about various parameters of atmosphere and meteorology and be able to predict their role in weather prediction and climate science. CLO 4: Have in-depth knowledge of the process of Atmospheric general circulation and atmospheric moisture.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		

Part B-Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	**Environmental Geo-science**: Origin of the Earth, Primary differentiation and formation of core, mantle, crust, magma generation, Earth's orbit, Kepler's laws of planetary motion. Structure of the Earth - the Geosphere, Atmosphere and Hydrosphere. Theory of Plate Tectonics – Wegener theory of continental drift, Holmes theory of convection in the mantle, Hess theory of sea floor spreading, Vine and Matthews theory of magnetic reversals and Glomar Challenger theory of age of oceanic floors.	15
II	Geomorphological Processes: Formations and classification of rocks rock cycle, Fold, and Fault, Major types of fold and faults. Weathering and their types, Mass wasting and its types Volcanism , types, volcanic materials , process and effects of volcanism. Transport and deposition of earth's material by running water, wind, glaciers. Thermal, magnetic and gravitational fields of earth. Soil profile, soil classification, soils of India.	15

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1121

III	Atmosphere: Composition and structure; heat budget, lapse rate , thermal inversion and mixing height; cloud formation, winds, coriolis force; waves and currents; ocean circulation and global pressure belt system, El nino, La nina and monsoons, Applied aspects of meteorology: weather and climate, spatial scales (micro, meso, synoptic and global scales), wind roses.	15
IV	**Weather and Climate**: Energy balance in atmosphere, greenhouse effect, Atmospheric general circulation. Atmospheric moisture: Forms of cloud condensation; Precipitation, Thunderstorms, floods and droughts. Global Climate variability and climate change. Introduction to weather forecasting models.	15
	Total Contact Hours	60

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**
• Class Participation:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		

PartC-Learning Resources

Recommended Books/e-resources/LMS:

1. Botkin, D.B. and Keller E.A (2004). *Environment Science: Earth as a Living Planet*. John Wiley & Sons Inc., New York.
2. Robert E. Ricklefs (2001). *The Ecology of Nature*. Fifth Edition, W.H. Freeman and Company.
3. Bennett, M. R. and Doyle, P. (1997). Environmental Geology: - Geology and the Human Environment. John Wiley and Sons.
4. Steffen, W., Sanderson, A., Tyson, P.D., Jager, J., Matson, P.M., Moore, III, B., Oldfield, F., Richardson, K., Schnellnhuber, H.J., Turner, II, B.L. and Wasson. R.J (2004). *Global change and the Earth System: A Planet under Pressure*. Springer-Verlag, New York, New York, USA Reference books.
5. Keller, E.A. (2007). *Introduction to Environmental Geology*. 4th ed. Prentice Hall of India.

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1122

Core Course (CC-2)

Session: 2024-25			
PartA - Introduction			
Name of Programme	M.Sc. Environmental Science		
Semester	Ist semester		
Name of the Course	Environmental and Green Chemistry		
Course Code	M24- EVS-102		
Course Type	CC-2		
Level of the course	400-499		
Pre-requisite for the course (if any)	Nil		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: Develop understanding on the concept of minerals, soil composition, properties and chemistry. CLO 2: Understand about composition and reactions in atmosphere, greenhouse gases and global warming. CLO 3: Obtain knowledge about water structure, composition, standards and aquatic chemistry. CLO 4: Know about the use of different biocatalysts as environmentally friendly reagents and industrial applications of green chemistry.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		

Part B-Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	Lithosphere and Soil chemistry: Chemical composition of the earth, origin of mineral deposits and fossil fuels, major rock forming minerals, elements and isotopes. Interaction between atmosphere, hydrosphere and lithosphere. Soil Profiles, chemical and mineralogical composition of soils; soil organic matter, soil nutrients; soil properties of fundamental importance in soil management.	15
II	Atmospheric Chemistry: Chemical composition of atmosphere-atmospheric water and CO_2; ions and radicals in atmosphere, formation of particulate matter, Photo-chemical and chemical reactions in the atmosphere, thermal inversion, particles in atmosphere; photochemical smog, acid rain, chemistry of ozone layer depletion; greenhouse gases and global warming.	15
III	Aquatic Chemistry: Structure and properties of water; water quality	15

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1123

	parameters, chemistry of inland water bodies- lakes, streams, rivers estuaries and wetlands, solubility of gases in water, carbonate system in water, redox reaction (oxidation-reduction); aquatic microbial chemistry-a brief account.	
IV	Green Chemistry: Definition, fundamental principles and tools. Catalysis for Green Chemistry: Use of biocatalysts- Biochemical Oxidation, Biochemical Reduction, Enzyme-Catalyzed Hydrolytic Process, Goals of Green Chemistry- Significance and basic components of green chemistry in research - industrial applications of green chemistry. Products from natural materials- Green fuels and E-Green propellants- Zeolites- Biocatalysts.	15
	Total Contact Hours	60

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**
• Class Participation:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Botkin, D.B. and Keller E.A (2004). *Environment Science: Earth as a Living Plant.* John Wiley & Sons Inc., New York.
2. Manahan, S.E. (2000). *Environmental Chemistry*. Seventh Edition. Lewis Publishers, New York
3. Mitsch, W.J. and Jorgensen, S.E. (eds.) (1989). *Ecological Engineering: An Introduction to Ecotechnology*. John Wiley and Sons, New York.
4. Pierzynski, G.M., Sims, J.T. and Vance, G.F. (2000). *Soils and Environmental Quality*. Second Edition. CRC press, New York.
5. Sanghi, R. and Srivastava, M. M. (Eds.). (2003). *Green Chemistry: Environment Friendly Alternatives*. Alpha Science Int'l Ltd.

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1124

Core Course (CC-3)

Session: 2024-25			
PartA - Introduction			
Name of Programme	M.Sc. Environmental Science		
Semester	Ist semester		
Name of the Course	Ecology and Ecosystem Dynamics		
Course Code	M24- EVS-103		
Course Type	CC-3		
Level of the course	400-499		
Pre-requisite for the course (if any)	Nil		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: Students will have in-depth knowledge about biotic and abiotic factors that are related to individual, population, community and ecosystem, as well as interrelationships CLO 2: The students will understand and be able to analyze evolutionary changes and environmental adaptations. CLO 3: Students will understand the concept of different food interactions, trophic levels, energy transfer, energy flow and sedimentary cycles. CLO 4: Student will analyze the importance of various ecosystems such as territorial ecosystems, freshwater ecosystems, ocean ecosystems and wetlands.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		

Part B-Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	Introduction : Aims and scope of ecology, biological levels of organization-genes biosphere; tolerance range and limiting factors, adaptations, ecotypes and ecads. Population ecology: Characteristics, evolutionary strategies r and k selection; population growth and regulation, Species Interactions: Competition, mutualism, parasitism, predator-prey relations, allelopathy, behavioural ecology-a brief accou	15
II	Community structure and Organization: nature of community, life-forms, vertical and horizontal stratification; functional role and niche, keystone species, ecotone and edge-effect; plant-animal interaction. Ecological Succession –concept, primary and secondary succession; concept of climax and types of climax; changes in ecosystem properties	15

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1125

	during succession.	
III	The Ecosystem concept, biotic and abiotic components; ecosystem processes-photosynthesis and decomposition; ecological pyramids, food webs, trophic levels, energy transfer, ecological efficiencies, models of energy flow. Biogeochemical cycles, gaseous and sedimentary cycles-carbon cycle, nitrogen cycle, sulphur cycle and phosphorus cycle, Man's impact on nutrient cycles.	15
IV	Biome and aquatic systems- distribution, characteristics, climate and biota. Distinguishing characters of forests, grasslands, and arid lands. A brief account of lakes and wetlands, and coral reefs. Natural and anthropogenic disturbances, Invasive species: ecology, impacts and control.	15
	Total Contact Hours	60

Suggested Evaluation Methods			
Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**
• Class Participation:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Brewer, R. (1994). The Science of Ecology, Sanders College Publishing Co., Tokyo.
2. Lieth, H. and Whittaker, R.H. (Eds). (1975). *Primary Productivity of the Biosphere.* Springer-Verlag, New York.
3. Odum, E.P and Barrett, G.W. (2004). Fundamentals of Ecology. 5th edition. Thomson Brooks/Cole, Belmont, California.
4. Odum, E.P. (1983). *Basic Ecology*, W.B. Saunders, Philadelphia.
5. Singh, J.S., Singh, S.P. and Gupta, S.R. (2015). *Ecology, Environment and Resource Conservation,* S. Chand Publishing, New Delhi.
6. Jakhar, S. (2024). *Fundamentals of Ecology*. Techsar Pvt. Ltd., New Delhi.
7. Smith, R.L. (1996), Ecology and Field Biology, Harper Collins, New York.
8. Townsend, C.R., Begon, M. and Harper, J.L. (2003). *Essentials of Ecology.* Second Edition. Blackwell Publishing, Oxford.

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1126

Core Course (CC-4)

Session: 2024-25			
Part A - Introduction			
Name of Programme	M.Sc. Environmental Science		
Semester	Ist semester		
Name of the Course	Environmental Modeling and Statistics		
Course Code	M24- EVS-104		
Course Type	CC-4		
Level of the course	400-499		
Pre-requisite for the course (if any)	Nil		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: Understand the idea, methodology and basic tools of environmental modeling, their scope, limitations and applications. CLO 2: Gain knowledge about different analytical models and their applications in Ecological studies. CLO 3: Describe how basic statistical methods can be used to analyze environmental data. CLO 4: Gain knowledge about experimental designs and computer graphics.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		

Part B-Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	Concept of models and ecosystem modeling; model classification- deterministic models, stochastic models steady state models dynamic models. Different stages involved in model building. Ecosystem stability, Cybernetics and ecosystem regulation. Ecoinformatics- A brief account and scope in environmental analysis.	15
II	Elementary aspects of System Analysis: Systems theory, ecological models- characteristics and applications, compartment model, matrix model, statistical model, mathematical model, energy circuit analog model. Box model, Gaussian plume model. Analytical models in Ecology: logistic model of population growth; Hardy- Weinberg model; Lotka - Volterra model of competition and predation; models of succession.	15
III	Statistics- Measures of central tendency – Mean, Median, Mode, Geometric Mean and Harmonic Mean, measures of dispersion, moments, standard deviation, variance skewness and kurtosis Basic laws of probability, definition of a random variable and concept of a probability density function; binominal,	15

Sandeep

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Kurukshetra-136119

1127

	poison and normal distributions.	
IV	Principles of experimental design-randomization; replication and local control, randomized block design; application of one-way and two-way analysis of variable. Correlation and linear regression of one independent variable. A basic idea of computer graphics, use of different software; information retrieval and data management.	15
	Total Contact Hours	60

Suggested Evaluation Methods			
Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**
• Class Participation:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		

PartC-Learning Resources

Recommended Books/e-resources/LMS:

1. Gomez, K.A. and Gomes, A.A. (1984). Statistical Procedures for Agricultural Research, John Wiley and Sons, New York.
2. Gupta S.C. (1981). Fundamentals of Statistics, Himalaya Publishing House, Mumbai.
3. Hoshmand, A.R. (1998). Statistical Methods for Environmental and Agricultural Sciences, CRP Press, New York.
4. John, W. and Mark, M. (Eds). (2004). Environmental Modeling: Finding Simplicity in Complexity, John Wiley and Sons Inc., New York.

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1128

Practicum Course PC- 1

Session: 2024-25			
Part A–Introduction			
Name of the Programme	M.Sc. Environment Science		
Semester	Ist Semester		
Name of the Course	Practical-I		
Course Code	M24- EVS-105		
Course Type	PC-1		
Level of the course	400-499		
Pre-requisite for the course (if any)	NA		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: Provide students with a comprehensive understanding of the principles, techniques, and applications of soil and water analysis CLO 2: Describe the significance of hardness in water quality and its impact on domestic, industrial, and agricultural use. CLO 3: Develop accuracy in executing standard operating procedures for soil analysis and to evaluate soil biological activity and health. CLO 4: Develop the ability to critically analyse experimental data and draw meaningful conclusions for domestic, industrial and agricultural use.		
Credits	**Theory**	**Practical**	**Total**
1	0	**4**	**4**
Teaching Hours per week	0	**8**	**8**
Internal Assessment Marks	0	**30**	**30**
End-Term Exam Marks	0	**70**	**70**
Max. Marks	0	**100**	**100**
Examination Time	0	6 hours	

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Kurukshetra-136119

1129

Part B-Contents of the Course	
Practicals	**Contact Hours**
1. To estimate the total hardness and temporary hardness of water. 2. To estimate total Ca and Mg content from given water samples. 3. To determine the organic carbon content in a given soil sample. 4. To determine the CO_2 evolution rate from a given soil sample. 5. To separate the soil aggregates from the given soil sample. 6. To determine the height of a particular point on a cliff with the help of a Brunton compass. 7. To determine the maximum water-holding capacity of a given soil sample. 8. To find out the pH of water and different soil samples. 9. To estimate the electrical conductivity of given soil and water solutions. 10. To estimate alkalinity in water samples. 11. To study the geological time scale 12. To study different types of maps (Climate, Geological, Agriculture crops) 13. Draw the wind roses from the given data and conclude the results. 14. To determine the soil texture with the help of the Soil Texture Triangle. 15. To determine available nitrogen in given soil sample by Kjeldhal method. 16. To determine free CO_2 in different water samples.	120

Suggested Evaluation Methods			
Internal Assessment: 30		**End Term Examination: 70**	
➢ **Practicum**	**30**	➢ **Practicum**	**70**
• Class Participation:	5	Lab record, Viva-Voce, write-up and execution of the practical	
• Seminar/Demonstration/Viva-voce/Lab records etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Rice, E. W., Bridgewater, L. and American Public Health Association (Eds.). (2012). *Standard methods for the examination of water and wastewater* (Vol. 10). Washington, DC: American Public Health Association.
2. Bartram, J. and Ballance, R. (1996). *Water quality monitoring: a practical guide to the design and implementation of freshwater quality studies and monitoring programmes*. CRC Press.
3. Jones, J. (2018). *Soil analysis handbook of reference methods*. CRC press.
4. Carter, M.R. and Gregorich, E.G. (2007). *Soil sampling and methods of analysis*. CRC press.
5. Boyd, C. E. (2019). *Water quality: an introduction*. Springer Nature.

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Sandeep

1130

Practicum Course (PC-2)

Session: 2024-25			
PartA - Introduction			
Name of the Programme	M.Sc. Environmental Science		
Semester	Ist semester		
Name of the Course	Practical-II		
Course Code	M24-EVS-106		
CourseType	PC-2		
Level of the course	400-499		
Pre-requisite for the course (if any)	Nil		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: Collect and interpret data related to ecological fieldwork using quadrat and transect methods. CLO 2: Apply statistical tools (Pearson's correlation, regression analysis, variance, standard deviation) to ecological data. CLO 3: Estimate chlorophyll content and analyzing leaf anatomy between C3 and C4 plants. CLO 4: Interpret ecological models, such as the logistic growth curve, nitrogen cycle compartment model, and box model for pollutant concentration.		
Credits	Theory	Practical	Total
	0	4	4
Teaching Hours per week	0	8	8
Internal Assessment Marks	0	30	30
End Term Exam Marks	0	70	70
Max. Marks	0	100	100
Examination Time	0	6 hours	

Part B-Contents of the Course

Practicals	Contact Hours
1. To estimate the chlorophyll content of C3 and C4 plants. 2. To determine the frequency distribution of plants in a patch of vegetation by quadrat method. 3. To study frequency, density, basal areas of plants by using line transect method. 4. To calculate the IVI of vegetation of a given area. 5. To calculate the Simpson index of plant diversity and to draw the dominance diversity curve. 6. To compare anatomy of C3 and C4 leaves. 7. To study invasive species in a given area. 8. To find a correlation between two sets of data by using Karl's pearson method. 9. To apply regression analysis on the given data.	120

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10. To prepare logistic growth curve for a hypothetical population. 11. To calculate the measures of central tendency from given set of data by using excel software. 12. To calculate SD variance and coefficient of variation from given set of data by using excel software. 13. To prepare compartment model of N_2 cycle in grassland ecosystem. 14. To prepare the flow diagram of century model. 15. To estimate pollutant concentration over an area by box model concept.	

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
➢ **Practicum**	**30**	➢ **Practicum**	**70**
• Class Participation:	5	Lab record, Viva-Voce, write-up and execution of the practical	
• Seminar/Demonstration/Viva-voce/Lab records etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1 Magurran, A. E. (2004). *Measuring Biological Diversity*. Blackwell Publishing.
2 Molles, M. C. (2015). *Ecology: Concepts and Applications*. McGraw-Hill Education.
3 Zar, J. H. (2010). *Biostatistical Analysis* (5th ed.). Pearson.
4 Taiz, L., Zeiger, E., Møller, I. M., & Murphy, A. (2015). *Plant Physiology and Development* (6th ed.). Sinauer Associates.
5 Southwood, T. R., & Henderson, P. A. (2000). *Ecological Methods* (3rd ed.). Wiley-Blackwell.

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1132

Seminar

Session: 2024-25	
Name of the Programme	M.Sc. Environmental Science
Semester	Ist Semester
Name of the Course	Seminar
Course Code	M24- EVS-107
Course Type: (CC/DEC/PC/Seminar/CHM/OEC/EEC)	Seminar
Level of the course	400-499
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: Demonstrate a sound technical knowledge of the seminar topic. CLO 2: Improves his/her presentation skills and develop confidence.
Credits	Seminar 2
Teaching Hours per week	2
Max. Marks	50
Internal Assessment Marks	0
End Term Exam Marks	50
Examination Time	1 hour
Instructions for Examiner: Evaluation of the seminar will be done by the internal examiner(s) on the parameters as decided by staff council of the department. There will be no external examination/viva-voce examination.	

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Core Course (CC-5)

Session: 2024-25			
Part A - Introduction			
Name of Programme	M.Sc. Environmental Science		
Semester	2nd Semester		
Name of the Course	Natural Resource Management		
Course Code	M24- EVS-201		
Course Type	CC-5		
Level of the course	400-499		
Pre-requisite for the course (if any)	Nil		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: Acquire knowledge about water and land resources and their conservation and management. CLO 2: Become familiar with various energy and mineral resources and their environmental impacts. CLO 3: Obtain knowledge about forest and marine resources, rangelands and deforestation. CLO 4: Develop understanding about economic categories of resources, theories and economically sustainable management of resources.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		

Part B-Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	Resources: Types, Renewable & non-renewable resources; resource degradation a conservation; Human impact on natural resources. Land resources: Land degradation and desertification; Soil erosion and control; reclamation & management of waste lands with special reference to India. Water resources: Pools of water and hydrological cycle; Surface water, ground w Human use of freshwater. Rain water harvesting; watershed management	15
II	Energy resources: Renewable & non-renewable. Fossil fuels, hydropower nuclear energy, solar energy, wind energy. Energy from biomass. Mineral resources: Origin, types, exploration and production, conservation and recycling, bacterial leaching of metals from low grade ores. Environmental issues related with mineral extraction and processing.	15

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Kurukshetra-136119

1134

III	Forest resources: Forests, their importance, types, global distribution; primary and secondary products, forest resources of India. Impact of deforestation; Sustainable forest Management. Range lands: Types, uses, grassland types and management in India. Medicinal plant resources and bioprospecting-a brief account. Fisheries and Marine resources- a general account; aquaculture	15
IV	Economics, environment and development: Economic categories of resources; the market, environment and natural resources; the economics theory- market, demand and supply relationships. The limit of growth; cost benefit ratio; natural resources accounting; market based mechanisms for environmental protection. Economically sustainable forest management designs- green certification, resource conservation, community forest management; ecotourism. Economic efficient model of sustainable fisheries; designs for renewable energy resources.	15
	Total Contact Hours	60

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**
• Class Participation:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Brown, L. (2001). *State of the World 2001.* World watch Institute in association with Earthscan, London.
2. Chape, S., Fish, L., Fox, P. and Spalding, M. (2003). *United Nations list of protected areas.* IUCN/UNEP/World Conservation Monitoring Centre, Gland, Switzerland/Cambridge
3. Cunningham, W.P. and Cunningham, M.A. (2002*). Environmental Science: Inquiry and Applications.* A Global Concern. Tata McGraw-Hill Publishing Company, New Delhi.
4. Singh, J.S., Singh, S.P. and Gupta, S.R. (2015). *Ecology, Environment and Resource Conservation,* S. Chand Publishing, New Delhi.

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1135

Core Course (CC-6)

Session: 2024-25			
PartA - Introduction			
Name of Programme	M.Sc. Environmental Science		
Semester	2nd Semester		
Name of the Course	Conservation and Biodiversity		
Course Code	M24- EVS-202		
Course Type	CC-6		
Level of the course	400-499		
Pre-requisite for the course (if any)	Nil		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: Become familiar with principles of conservation biology and acquire knowledge about levels of biodiversity. CLO 2: Build an understanding about biodiversity patterns, biodiversity of mangroves, wetlands and coral reefs. CLO 3: Gain knowledge about biodiversity uses, services and threats to biodiversity (aquatic and marine). CLO 4: Become familiar with the various biodiversity conservation strategies and approaches.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		

Part B - Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	Principles and importance of conservation biology; genetic variations, r selection, genetic drift and gene flow, minimum viable populations, genetic swam Biodiversity, magnitude, global accumulation; levels biodiversity- species, genet ecosystem diversity; species diversity indices, rank abundance patterns.	15
II	Biodiversity gradient – latitudinal and altitudinal, regional patterns of biodiversity; factors affecting biodiversity patterns; Biodiversity and ecosystem functioning; Terrestrial and marine hotspot of biodiversity. Biodiversity of mangroves, wetlands and coral reefs – A general account.	15
III	Biodiversity uses and ecosystem services; threats to biodiversity- habitat loss, habitat fragmentation, exotic species and environmental pollution; species extinction ; IUCN threat categories- global and national status; Threats to aquatic and marine biodiversity. Endangered and threatened species of India; Biodiversity assessment and	15

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1136

	monitoring.	
IV	In situ Biodiversity conservation strategies and approaches: Protected areas, biosphere resource, protected areas in India – Sanctuaries, national parks and biosphere resources. Ex Situ Biodiversity conservation: Species management plans, captive breeding, field gene banks, seed gene banks, cryopreservation, gene banks. National and international efforts for biodiversity conservation- CITES, Ramsar Convention, Convention on biological diversity, IPR and Patent rights.	15
	Total Contact Hours	60

Suggested Evaluation Methods			
Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**
• Class Participation:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Chandel, K.P.S., Shukla, G. and Sharma, N. (1996). Biodiversity in Medicinal and Aromatic Plants in India Conservation and Utilization, National Bureau of Plant Genetic Resources, New Delhi.
2. Heywood, V. (ed.) (1995). Global Biodiversity Assessment. United Nations Environment Programme, Cambridge University Press, Cambridge, U.K.
3. Huston, M.A. (1994). *Biological Diversity: The Coexistence of Species on Changing Landscapes*. Cambridge University Press, Cambridge.
4. Singh, J.S., Singh, S.P. and Gupta, S.R. (2015). *Ecology, Environment and Resource Conservation*, S. Chand Publishing, New Delhi.
5. Soule, M.E. (ed.) (1986): Conservation Biology. The Science of Scarcity and Diversity. Sinaur Associates, Inc., Sunderland, Massachusetts.

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1137

Core Course (CC-7)

Session: 2024-25			
Part A - Introduction			
Name of Programme	M.Sc. Environmental Science		
Semester	2nd Semester		
Name of the Course	Environmental Pollution		
Course Code	M24- EVS-203		
Course Type	CC-7		
Level of the course	400-499		
Pre-requisite for the course (if any)	Nil		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: Identify and quantify the magnitude and intensity of ambient air pollution. CLO 2: Understand the sources, effects and control of indoor air pollution. CLO 3: Assess the causes and sources of water and soil pollution and to treat them. CLO 4: Understand the sources and effects fate of noise and radioactive pollutants.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		

Part B-Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	Pollution: Definition and Types. Pollutants and contaminants: Definition, Primary and secondary pollutants, point source and non-point source pollutants. Air Pollution: definition, sources of ambient air pollution, major ambient air pollutants, criteria pollutants, Trans boundary pollution, air quality index, the effects of air pollution, measurements of pollutants, air pollution control technologies. Air quality standards.	15
II	Indoor Air Pollution: Types, Causes and Effects, Indoor Combustion, Biological Pollutants, Radon, Carbon monoxide, Asbestos, Formaldehyde. Control Measures for indoor air pollution, sick-building syndrome and building related illness.	15
III	Water pollution: Causes and effects of surface water, groundwater, marine water and thermal pollution. Control measures of water pollution. Case studies. Water quality guidelines. Soil pollution: Causes and effects. Behavior and fate of soil pollutants Remedial measures of soil pollution. Self cleaning ability of soil environment.	15
IV	Noise pollution-Sources and measurement indices of noise pollution,	15

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1138

	Noise exposure level and standards, Noise control and abatement measures, Impact of noise on human health, Mitigation of noise Pollution. Radioactive pollution: Sources, effects and control.	
	Total Contact Hours	60

Suggested Evaluation Methods			
Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**
• Class Participation:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		

PartC-Learning Resources

Recommended Books/e-resources/LMS:

1. Mirsal, IA. (2008). Soil Pollution Origin, Monitoring & Remediation, Springer-Verlag Berlin Heidelberg.
2. Manahan, S.E. (2000). *Environmental Chemistry*. Seventh Edition. Lewis Publishers, New York
3. Pierzynski, G.M., Sims, J.T. and Vance, G.F. (2000). *Soils and Environmental Quality*. Second Edition. CRC press, New York.
4. Botkin, D.B. and E.A. Keller (2004). *Environment Science: Earth as a Living Planet*. John Wiley & Sons Inc., New York.
5. Miller Jr., G.T. (1997). *Environmental Science: Working With the Earth*. Wadsworth Publishing Company, Belmont, California

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1139

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Core Course (CC-8)

Session: 2024-25			
PartA - Introduction			
Name of Programme	M.Sc. Environmental Science		
Semester	2nd Semester		
Name of the Course	Environmental Methods and Analytical Techniques		
Course Code	M24- EVS-204		
Course Type	CC-8		
Level of the course	400-499		
Pre-requisite for the course (if any)	Nil		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: Learn characters of vegetation and measurement of biodiversity with different methods. CLO 2: Use microbiology knowledge and skills to analyze environmental problems involving microbes. CLO 3: Demonstrate a broad and coherent knowledge and understanding of analytical chemistry and instrumental methods of analysis (photometry, spectrophotometry, chromatography). CLO 4: Use spectroscopic techniques to analyze various pollutants in environment and understand theory and techniques for their measurements of pollutants.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		

Part B-Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	Analytic and synthetic characters of vegetation, methods of vegetation analysis; Species diversity and measurement of diversity; primary and secondary production, methods of measuring primary productivity; techniques for quantifying nitrogen fixation; estimation of ecosystem nutrient budget. Germ plasm evaluation and conservation- survey, inventorization, and analysis.	15
II	Techniques in environmental microbiology and its applications. Methods of analyzing soil microbial populations and diversity Measurement of microbial activity in environmental samples: microbial biomass, nitrogen mineralization soil respiration, microbial respiration and enzymatic activities. Assessment and characterization of arbuscular mycorrhizal fungal	15

Sandeep

1140

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Institute of Environmental Studies
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	the soil-plant system.	
III	Instrumentation Principles and applications of Spectrophotometry (UV-Visible spectrophotometry, flame photometry, Atomic Absorption spectrophotometry); Chromatographic techniques (Paper chromatography, thin layer chromatography, Gas liquid chromatography, High pressure liquid chromatography, Ion exchange chromatography, Column chromatography), Fluorometry, X-ray diffraction.	15
IV	Analytical Techniques: Air, Water and Soil samples. Sampling and analysis of air pollutants. Chemical and bacteriological sampling and analysis, water quality parameters, criteria and standards. Soil analysis - sample preparation and chemical methods of soil analysis. Vocational prospects in field of environmental analysis and research.	15
	Total Contact Hours	60

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**
• Class Participation:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		

PartC-Learning Resources

Recommended Books/e-resources/LMS:

1. Chapin, F.S., Matson, P.A. and Mooney, H.A. (2002). *Principles of Terrestrial Ecosystem Ecology*. Springer-Verlag, New York
2. Clark, R.N. (1999). *Spectroscopy of Rocks and Minerals, and Principles of Spectroscopy*. U.S. Geological Survey, Denver
3. John Wainwright and Mark Mulligan (Eds). (2004). *Environmental Modeling: Finding Simplicity in Complexity*. John Wiley & Sons Inc., New York.
4. Manahan, S.E. (2000). *Environmental Chemistry*. Seventh Edition. Lewis Publishers, New York

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1141

Practicum Course (PC-3)

Session: 2024-25			
PartA - Introduction			
Name of the Programme	M.Sc. Environmental Science		
Semester	2nd Semester		
Name of the Course	Practical-III		
Course Code	M24-EVS-205		
CourseType	PC-3		
Level of the course	400-499		
Pre-requisite for the course (if any)	Nil		
Course Learning Outcomes(CLO) After completing this course, the learner will be able to:	1. Plot a standard graph or calibration curve and determine protein concentration from any sample. 2. Determine species diversity indices from the given community data. 3. Estimate Acid, Detergent, Fiber content from the given plant material and oil content from given seed sample. 4. Plot the water budget of the earth, groundwater system, sedimentary basin, and soil types of India.		
Credits	Theory	Practical	Total
	0	4	4
Teaching Hours per week	0	8	8
Internal Assessment Marks	0	30	30
End Term Exam Marks	0	70	70
Max. Marks	0	100	100
Examination Time	0	4 hours	

Part B-Contents of the Course

Practical's	Contact Hours
1. To determine the oil content from various oil yielding plants by using Soxhlet extractor apparatus. 2. To draw the calibrations curve of Bovine Serum Albumin with protein binding dye (Brad ford method). 3. To determine the Acid Detergent Fiber (ADF) content from the given plant material. 4. To determine the Simpson Dominance - Diversity Index from a given set of community data. 5. To determine α, β and γ biodiversity from the given set of community data. 6. To determine Shanon Weiner's diversity index from a given community data set. 7. Visit the Herbal Garden (List of Medicinal Plants). 8. Discuss and plot the water budget of earth in Pi-Diagram 9. Plot groundwater system in a block diagram and show confined aquifer, unconfined aquifer and artesian condition of a well.	120

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1142

10. To study various designs of rooftop water harvesting systems. 11. Divide world into different natural regions and note their characteristic of climate, soil vegetation flora and fauna. 12. To study the physiographic, soil type, vegetation of India. 13. Plot sedimentary basin map of India and delineate different petroliferous basins. 14. To study the Moho's scale of hardness. 15. To study the physical properties of some important minerals.	

SuggestedEvaluationMethods

InternalAssessment: 30		**End Term Examination: 70**	
➢ **Practicum**	**30**	➢ **Practicum**	**70**
• Class Participation:	5	Lab record, Viva-Voce, write-up and execution of the practical	
• Seminar/Demonstration/Viva-voce/Lab records etc.:	10		
• Mid-Term Exam:	15		

PartC-Learning Resources

Recommended Books/e-resources/LMS:

1. Magurran, A. E. (2004). *Measuring Biological Diversity*. Blackwell Publishing.
2. Singh, J.S., Singh, S.P. and Gupta, S.R. (2015). *Ecology, Environment and Resource Conservation*. S. Chand Publishing, New Delhi.
3. Aery, N. C. (2010). *Manual of environmental analysis*. Ane Books Pvt Ltd.
4. Mitchell, B. (2013). *Resource and environmental management*. Routledge.
5. Jain, S. K. and Singh, V. P. (2023). *Water resources systems planning and management*. Elsevier.

Sandeep

1143

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Practicum Course (PC-4)

Session: 2024-25			
PartA - Introduction			
Name of the Programme	M.Sc. Environmental Science		
Semester	2nd semester		
Name of the Course	Practical-IV		
Course Code	M24- EVS-206		
CourseType	PC		
Level of the course	400-499		
Pre-requisite for the course (if any)	-----		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	1. Understand the principles of microbiological techniques and methods (serial dilution and agar plating method) and assess soil microbial diversity and population diversity. 2. Evaluate the forest and grassland productivity and ecological significance of agroforestry systems. 3. Estimate physio-chemical properties of water samples; assess water quality and suitability to various uses. 4. To analyze particulate matter and different gases in the ambient air.		
Credits	Theory	Practical	Total
	0	4	4
Teaching Hours per week	0	8	8
Internal Assessment Marks	0	30	30
End Term Exam Marks	0	70	70
Max. Marks	0	100	100
Examination Time	0	4 hours	

Part B-Contents of the Course

Practicals	Contact Hours
1. To compute the Mean Annual Increment (MAI) and Annual Increment (AI) in a forestry plant area for given set of data 2. To analyse above ground and below ground productivity of an agroforestry system on the basis Dbh . 3. To determine the total plant biomass of a grass land system by harvest method. 4. To determine the dissolved oxygen (DO) content in a given water sample by WINKLER's Method. 5. To determine the carbonate and bicarbonate content from the given water sample. 6. To determine chemical oxygen demand (COD) of a given wastewater sample 7. To isolate and enumerate micro-organisms from soil by serial dilution agar plating method. 8. To isolate Vesicular Arbuscular Mycorrhizal (VAM) spores from the soil. 9. To measure the concentration of particulate matter PM2.5 using High-volume sampler. 10. To measure the concentration of particulate matter PM10 using High-volume sampler. 11.To Measure the concentration of Carbon Monoxide (CO) Using Non-Dispersive	120

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1144

Infrared (NDIR) instrument. 12. To measure concentration of NO_2 concentration using the Jacobs & Hochheiser method. 13. To determine the concentration of SO_2 using modified West and Geake method. 14. To prepare basic solid media and to study microflora of indoor and outdoor air. 15. To perform Lactophenol blue staining of fungi isolated from air. 16. To determine λmax of the given chemical compound using spectrophotometer.	

Suggested Evaluation Methods			
Internal Assessment: 30		**End Term Examination: 70**	
➢ **Practicum**	**30**	➢ **Practicum**	**70**
• Class Participation:	5	Lab record, Viva-Voce, write-up and execution of the practical	
• Seminar/Demonstration/Viva-voce/Lab records etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Hurst, C. J., Crawford, R. L., Garland, J. L. and Lipson, D. A. (Eds.). (2007). *Manual of environmental microbiology*. American Society for Microbiology Press.
2. Pansu, M. (2006). *Handbook of soil analysis*. Springer.
3. Paul, E., & Frey, S. (Eds.). (2023). *Soil microbiology, ecology and biochemistry*. Elsevier.
4. Pavia, D. L., Lampman, G. M., Kriz, G. S. and Vyvyan, J. R. (2015). *Introduction to spectroscopy*.
5. Rice, E. W., Bridgewater, L. and American Public Health Association (Eds.). (2012). *Standard methods for the examination of water and wastewater* (Vol. 10). Washington, DC: American public health association.
6. West, P. W. and West, P. W. (2009). *Tree and forest measurement* (Vol. 20). Berlin: Springer.

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(1145)

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Scheme of Examination
for
Post Graduate Programme

M.Sc. Applied Geology

as per NEP 2020
Curriculum and Credit Framework for Postgraduate Programme

With Multiple Entry-Exit, Internship and CBCS-LOCF
With effect from the session 2024-25 (in phased manner)

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49 (1146)

Programme Learning Outcomes (PLOs) for PG Programmes in Applied Geology as per NEP-2020

PLOs	Master Degree in Applied Geology
	After the completion of Master degree in Applied Geology the student will be able to:
PLO-1: Knowledge and Understanding	Demonstrate the fundamental and advanced knowledge of the subject and understanding of recent developments and issues, including methods and techniques, related to the **Applied Geology.**
PLO-2: General Skills	Acquire the general skills required for performing and accomplishing the tasks as expected to be done by a skilled professional in the fields of **Applied Geology**.
PLO-3: Technical/ Professional Skills	Demonstrate the learning of advanced cognitive technical/professional skills required for completing the specialized tasks related to the profession and for conducting and analyzing the relevant research tasks indifferent domains of the **Applied Geology**.
PLO-4: Communication Skills	Effectively communicate the attained skills of the **Applied Geology** in well-structured and productive manner to the society at large.
PLO-5: Application of Knowledge and Skills	Apply the acquired knowledge and skills to the problems in the subject area, and to identify and analyze the issues where the attained knowledge and skills can be applied by carrying out research investigations to formulate evidence-based solutions to complex and unpredictable problems associated with the field of **Applied Geology** or otherwise.
PLO-6: Critical thinking and Research Aptitude	Attain the capability of critical thinking in intra/inter-disciplinary areas of the **Applied Geology** enabling to formulate, synthesize, and articulate issues for designing of research proposals, testing hypotheses, and drawing inferences based on the analysis.
PLO-7: Constitutional, Humanistic, Moral Values and Ethics	Know constitutional, humanistic, moral and ethical values, and intellectual property rights to become a scholar/professional with ingrained values in expanding knowledge for the society, and to avoid unethical practices such as fabrication, falsification or misrepresentation of data or committing plagiarism.
PLO-8: Capabilities/qualities and mindset	To exercise personal responsibility for the outputs of own work as well as of group/team and for managing complex and challenging work(s) that requires new/strategic approaches.
PLO-9: Employability and job-ready skills	Attain the knowledge and skills required for increasing employment potential, adapting to the future work and responding to the rapidly changing demands of the employers/industry/society with time.

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Scheme of Examination for Postgraduate Programme M.Sc. Applied Geology as per NEP 2020 Curriculum and Credit Framework for Postgraduate Programmes (CBCS-LOCF) with effect from the session 2024-25 (in phased manner)

Framework-2
Scheme-P

Semester	Course Type	Course Code	Nomenclature of course	Theory (T)/ Practical (P)/Seminar (S)	Credits		Contact hours per week L: Lecture P: Practical S: Seminar				Internal Assessment Marks	End Term Examination Marks	Total Marks	Examination hours
						Total	L	S	P	Total				
1	CC-1	M24-GGY-101	Fundamentals of Geology-I	T	4	26	4	0	0	4	30	70	100	3
	CC-2	M24-GGY-102	Fundamentals of Geology-II	T	4		4	0	0	4	30	70	100	3
	CC-3	M24-GGY-103	Physics and Chemistry of the Earth	T	4		4	0	0	4	30	70	100	3
	CC-4	M24-GGY-104	Mineralogy and Crystallography	T	4		4	0	0	4	30	70	100	3
	PC-1	M24-GGY-105	Geology Lab-I (Practical based on M24-GGY-101, M24-GGY-102 & Field Work)	P	4		0	0	8	8	30	70	100	4
	PC-2	M24-GGY-106	Geology Lab-II (Practical based on M24- GGY-103 & M24-GGY-104)	P	4		0	0	8	8	30	70	100	4
	SEMINAR	M24-GGY-107	Seminar	S	2		0	0	0	2	0	50	50	1
2	CC-5	M24-GGY-201	Palaeontology and Stratigraphy	T	4	26	4	0	0	4	30	70	100	3
	CC-6	M24-GGY-202	Structural Geology and Tectonics	T	4		4	0	0	4	30	70	100	3
	CC-7	M24-GGY-203	Environmental Geology	T	4		4	0	0	4	30	70	100	3
	CC-8	M24-GGY-204	Sedimentology and Geomorphology	T	4		4	0	0	4	30	70	100	3
	PC-3	M24-GGY-205	Geology Lab-III (Practical based on M24- GGY-	P	4		0	0	8	8	30	70	100	4

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1148

		201 & M24-GGY-202)											
PC-4	M24-GGY-206	Geology Lab-IV (Practical based on M24- GGY-203 & M24-GGY-204)	P	4		0	0	8	8	30	70	100	4
CHM	M24-CHM-201	Constitutional, Human and Moral values, and IPR	T	2		2	0	0	2	15	35	50	3
Internship	M24-INT-200	**An internship course of 4 Credits of 4-6 weeks duration during summer vacation after IInd semester is to be completed by every student. Internship can be either for enhancing the employability or for developing the research aptitude.**								50	50	100	-
CC-9	M24-GGY-301	Advanced Igneous and Metamorphic Petrology	T	4		4	0	0	4	30	70	100	3
CC-10	M24-GGY-302	Geohydrology	T	4		4	0	0	4	30	70	100	3
DEC-1 **(Any one from M24-GGY-303/304/305/306)**	M24-GGY-303	Coal and Petroleum Geology	T	4		4	0	0	4	30	70	100	3
	M24-GGY-304	Geoscientific Instrumentation and Analytical Techniques	T	4		4	0	0	4	30	70	100	3
	M24-GGY-305	Isotope Geochemistry	T	4		4	0	0	4	30	70	100	3
	M24-GGY-306	Sequence Stratigraphy	T	4		4	0	0	4	30	70	100	3
DEC-2 **(Any one from M24-GGY-307/308/309/310)**	M24-GGY-307	Engineering Geology	T	4	26	4	0	0	4	30	70	100	3
	M24-GGY-308	Computational Geology	T	4		4	0	0	4	30	70	100	3
	M24-GGY-309	Gemology	T	4		4	0	0	4	30	70	100	3
	M24-GGY-310	Geoexploration	T	4		4	0	0	4	30	70	100	3
PC-5	M24-GGY-311	Geology Lab-V (Practical based on M24- GGY-301, M24-GGY-302 & Field Work)	P	4		0	0	8	8	30	70	100	4
PC-6	M24-GGY-312	Geology Lab-VI (Practical based on DEC-1 & DEC-2)	P	4		0	0	8	8	30	70	100	4

3

3

1149

	OEC (To be offered to the students of other departments)	M24-OEC-318	Geoscience and Society	T	2		2	0	0	2	15	35	50	3
4	CC-11	M24-GGY-401	Geoinformatics	T	4	26	4	0	0	4	30	70	100	3
	CC-12	M24-GGY-402	Palaeoecology, Palaeoclimatology and Palaeogeography	T	4		4	0	0	4	30	70	100	3
	DEC-3 (Any one from M24-GGY-403/404/405/406)	M24-GGY-403	Applied Geochemistry	T	4		4	0	0	4	30	70	100	3
		M24-GGY-404	Oceanography and Marine Geology	T	4		4	0	0	4	30	70	100	3
		M24-GGY-405	Surveying	T	4		4	0	0	4	30	70	100	3
		M24-GGY-406	Ore Geology and Mineral Economics	T	4		4	0	0	4	30	70	100	3
	DEC-4 (Any one from M24-GGY-407/408/409/410)	M24-GGY-407	Mining Geology	T	4		4	0	0	4	30	70	100	3
		M24-GGY-408	Disaster Management	T	4		4	0	0	4	30	70	100	3
		M24-GGY-409	Geomechanics	T	4		4	0	0	4	30	70	100	3
		M24-GGY-410	Field Geology	T	4		4	0	0	4	30	70	100	3
	PC-7	M24-GGY-411	Geology Lab-VII (Practical based on M24-GGY-401 & M24-GGY-402)	P	4		0	0	8	8	30	70	100	4
	PC-8	M24-GGY-412	Geology Lab-VIII (Practical based on DEC-3 & DEC-4)	P	4		0	0	8	8	30	70	100	4
	EEC	M24-GGY-413	Entrepreneurship Approaches in Geology	T	2		2	0	0	2	15	35	50	3

Or

(Scheme of Semester IV when a student opts for Dissertation or Project Work)

4	CC-11	M24-GGY-401	Geoinformatics	T	4		4	0	0	4	30	70	100	3

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DEC-3 **(Any one from M24-GGY-403/404/405/406)**	M24-GGY-403	Applied Geochemistry	T	4	26	4	0	0	4	30	70	100	3
	M24-GGY-404	Oceanography and Marine Geology	T	4		4	0	0	4	30	70	100	
	M24-GGY-405	Surveying	T	4		4	0	0	4	30	70	100	3
	M24-GGY-406	Ore Geology and Mineral Economics	T	4		4	0	0	4	30	70	100	3
DEC-4 **(Any one from M24-GGY-407/408/409/410)**	M24-GGY-407	Mining Geology	T	4		4	0	0	4	30	70	100	3
	M24-GGY-408	Disaster Management	T	4		4	0	0	4	30	70	100	3
	M24-GGY-409	Geomechanics	T	4		4	0	0	4	30	70	100	3
	M24-GGY-410	Field Geology	T	4		4	0	0	4	30	70	100	3
EEC	M24-GGY-413	Entrepreneurship Approaches in Geology	T	2		2	0	0	2	15	35	50	3
Dissertation/Project work	M24-GGY-414	Dissertation	D	12		0	0	0	-	0	300	300	-
TOTAL CREDITS					**108**	**TOTAL MARKS**						**2700**	

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1151

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Syllabus of the Programme
for
Post Graduate Programme

M.Sc. Applied Geology

as per NEP 2020
Curriculum and Credit Framework for Postgraduate Programme

With Multiple Entry-Exit, Internship and CBCS-LOCF
With effect from the session 2024-25 (in phased manner)

DEPARTMENT OF GEOLOGY
FACULTY OF SCIENCE

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1152

Session: 2024-25			
Part A - Introduction			
Name of Programme	M.Sc. Applied Geology		
Semester	I		
Name of the Course	**Fundamentals of Geology-I**		
Course Code	M24-GGY-101		
Course Type	CC-1		
Level of the course	400-499		
Pre-requisite for the course (if any)	Nil		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 101.1: Know about the basics of geology, its related disciplines and its relation with mankind. CLO 101.2: Gain knowledge about the basics of mineralogy and petrology. CLO 101.3: Identify and classify rocks and minerals based on various physical properties and know the basics of structural Geology. CLO 101.4: Gain knowledge regarding the basics of surveying instruments and the techniques applicable in the field.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		

Part B- Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	Earth science: its subdivisions and relation to other sciences. Historical development of geological thoughts. Geo-morphological processes: exogenic processes, weathering, erosion, transportation and deposition by wind, river, glacier, waves and tides.	15
II	Chemical nature of minerals. Isomorphism, solid solution and Polymorphism. Physical properties of minerals, classification of minerals. Common rock forming and ore minerals. Rock cycle. Texture, structure, mineralogy and classification of igneous rocks. Sedimentary rocks and their texture, mineralogy and classification. Texture, structures, mineralogy and classification of metamorphic rocks. Metamorphic facies.	15
III	Primary and secondary structures in rocks, stress and strain, behaviour of rocks under stress. folds, faults, joints and unconformities- their definition, classification and criteria for recognition in the field and on maps. Shear zones, transform faults, and lineaments. Elementary idea about Engineering Geology and its significance, geological materials used in construction.	15

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1153

IV	Principles of surveying and leveling, methods of surveying by chain, plane table, compass, dumpy level, theodolite and total station. Use of field instruments such as Pocket compass, Prismatic compass, Clinometer compass, Brunton compass, Abney level, Pedometer and Altimeter. Indexing and reading of toposheets.	15
	Total Contact Hours	60

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**
• Class Participation:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. *Understanding the Earth*, Press, F. and Siever, R., W.H. Freeman & Co.
2. *Physical Geology*, Moore, J.S. and Wicander, R., Brooks-Cole.
3. *An Outline of Structural Geology*, Hobbs, M.B.E., Means, W.D. and Williams, P.F., John Wiley & Sons.
4. *Structural Geology: An Introduction to Geometrical Techniques*, Ragan, D.M., John Wiley & son.
5. *Fundamentals of Structural Geology*, Pollard, D.D. and Fletcher, R.C., Cambridge University Press.
6. *Structural Geology*, Billings, M.P., Prentice Hall India.
7. *Danas Manual of Mineralogy*, Klein, C., Cornelius, S.H., and Dana, J.D., John Wiley & Sons.
8. *An Introduction to the Rock-Forming Minerals*, Deer, W.A., Howie, R.A. and Zussman, J., ELBS and Longman.
9. *Rutley's Elements of Mineralogy*, Read, H.H., Springer.
10. *Introduction to Mineral Sciences*, Putnis, A., Cambridge University press.
11. *Igneous and Metamorphic Petrology*, Best, M.G., Blackwell.
12. *Igneous and metamorphic petrology*, Turner, F.J. and Verhoogen, J., CBS Publishers.
13. *Igneous Petrology*, Best, M.G., CBS Publishers.
14. *Igneous Petrogenesis*, Wilson, M., Springer.
15. *Igneous Petrology*, Bose, M.K., World Press.
16. *An Introduction to Metamorphic Petrology*, Yardley, B.W.D., Longman series, Prentice Hall.
17. *Surveying, Volume I*, Punmia, B.C. and Jain, A., Laxmi publications (P) Ltd.
18. *Surveying and Leveling, Part I*, Kanetkar, T.P. and Kulkarni, S.V., Pune Vidyarthi Griha Prakashan, Pune.
19. *Surveying, Volume II*, Punmia, B.C., Laxmi Publications (P) Ltd.
20. *Surveying and leveling, Part II*, Kanetkar, T.P. and Kulkarni, S.V., Pune Vidyarthi Griha Prakashan, Pune.

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Session: 2024-25			
Part A - Introduction			
Name of Programme	M.Sc. Applied Geology		
Semester	I		
Name of the Course	**Fundamentals of Geology-II**		
Course Code	M24- GGY-102		
Course Type	CC-2		
Level of the course	400-499		
Pre-requisite for the course (if any)	NIL		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 102.1: Understand different types of fossils and their various uses to mankind. CLO 102.2: Get to know about the geological time scale and stratigraphic division of India. CLO 102.3: Provide knowledge regarding various types of deposits of ores, petroleum and coal, their distribution and usefulness to mankind. CLO 102.4: Understand the basics and importance of sustainable development and environmental geology to society.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		

Part B- Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course-learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	Fossils, fossilization processes (taphonomy), modes of preservation, index fossils. Geological time scale, life through geological past, major mass extinctions in the geological past and significance of fossils.	15
II	Broad outline of physiographic and tectonic framework of India. Stratigraphic principles, introduction to lithostratigraphy, biostratigraphy, chronostratigraphy and magnetostratigraphy.	15
III	Classification of ore deposits, igneous, metamorphic and sedimentary processes of formation of ore deposits, hydrothermal process, supergene enrichment, evaporites and anoxic deposits, stratified and strata-bound deposits etc. Concept of ore, gangue, tenor, grade and specifications. Distribution and geological set up of important metallic and non-metallic mineral deposits of India including coal, petroleum and atomic minerals.	15
IV	Basic principles of environment and ecosystem in relation to Geology. Anthropogenic activities and their impact on the environment. Depleting natural resources and sustainable development, conservation of mineral	15

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1155

	resources, mitigation of pollution and environmental hazards and geogenic contamination of groundwater.	
	Total Contact Hours	60

Suggested Evaluation Methods			
Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**
• Class Participation:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. *Geology of India and Burma*, Krishnan, M. S. CBS Publishers.
2. *Palaeontology*, Jain, P.C. and Anantharaman, M.S., Vishal Publishing Co.
3. *Economic mineral deposits*, Bateman, A.M., Jensen, M.L., John Wiley and Sons.
4. *Ore Deposits of India*, Gokhale and Rao, Thomson Press, Delhi.
5. *India's mineral resources*, Krishnaswami S., New Delhi, Oxford and IBH Pub. Co.
6. *Handbook of minerals, Crystals, Rocks and Ores*, Parmod, A.O., New India Publishing Agency.
7. *Economic Geology – Economic Mineral Deposits of India,* Prasad, U., CBS Publishers.
8. *Natural Disasters*, Alexander, D. UCL Press Ltd, Univ College London.
9. *Mitigation of Natural hazards and disasters: international perspectives*, Haque, C. Emdad., Dordrecht, Springer.
10. *Environmental Geosciences*, Keller, E.A., Prentice Hall, New Jersey.
11. *Fundamental of Historical Geology and Stratigraphy*, Kumar Ravinder., New Age International Publishers.

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1156

Session: 2024-25			
Part A -Introduction			
Name of Programme	M.Sc. Applied Geology		
Semester	**I**		
Name of the Course	**Physics and Chemistry of the Earth**		
Course Code	M24-GGY-103		
Course Type	CC-3		
Level of the course	400-499		
Pre-requisite for the course (if any)	NIL		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 103.1: Know about the Earth and its relation to other planets. Importance of Earth science to mankind. CLO 103.2: Acknowledge earth's interior and the dynamic processes of Earth. CLO 103.3: Understand the concept of Earth's magnetic field and its application. CLO 103.4: Understand tectonic evolution of the Himalayas and the Indian shield the significance of geochronology, dating techniques.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		

Part B- Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	Theories of origin of Earth: Catastrophic and evolutionary theories. Brief review of knowledge about the solar system. Abundance of the elements in the solar system and earth. The Earth in relation to other planets and major surface features of the Earth. The Earth-Moon system.	15
II	The Earth's interior: the nature of the crust-mantle boundary, low velocity zone in the upper mantle, chemical composition and mineralogy of the Earth's crust, mantle and core, evidence from experimental petrology & study of meteorites, geochemical evolution of the Earth, thermal evolution and state of Earth, continental and oceanic heat flow and convection in mantle.	15
III	Earthquakes, global seismicity, Earth's internal structure derived from seismology, continental drift, earth's magnetic field,	15

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1157

	origin of geomagnetic fields, paleomagnetism, polar wandering, sea-floor spreading, plate tectonics, triple junctions, hot spots & plumes.	
IV	Major features of the Earth's gravitational field and their relationship with tectonic processes in crust and upper mantle. Geochronology: radiometric dating and its significance, mountain belts and new global tectonics, tectonic evolution of the Himalaya and the Indian shield.	15
	Total Contact Hours	60

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**
• Class Participation:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. *The Solid Earth*, Fowler, C.M.R., Cambridge University Press, New York,
2. *Understanding Earth*, Gauss, I.G., Smith, P.S. and Wilson, R.G.L., MIT Press.
3. *The Dynamic earth - A textbook in Geosciences*, Wyllie, P.J., Wiley.
4. *Physics and Geology*, Jacobs, J.J., Russel, R.D. and Wilson, J.T., McGraw Hill.
5. *Fundamental of Geodynamics*, Schiedegger, A.E., Springer.
6. *Aspects of tectonics: focus on south-central Asia*, Valdiya, K.S., Tata Mc Graw Hill.
7. *The Inaccessible Earth*, Brown, G.C. and Mussett, A.E., Chapman and Hall.
8. *Understanding the Earth*, Brown, J., Hawkesworth, C.,and Wilson, C., Paperback, Book Depository, U.S.A.
9. *Earth*, Siever, R., Frank Press.
10. *Plate Tectonics & Crustal Evolution*, Condie, K.C., Butterworth-Heinemann Ltd.

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1158

Session: 2024-25			
Part A - Introduction			
Name of Programme	M.sc Applied Geology		
Semester	**I**		
Name of the Course	**Mineralogy and Crystallography**		
Course Code	M24-GGY-104		
Course Type	CC-4		
Level of the course	400-499		
Pre-requisite for the course (if any)	NIL		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 104.1: Understand crystal systems CLO 104.2: Recognize optical properties of various mineral groups and its application in various geological techniques. CLO 104.3: Know about mineral optics and structure. CLO 104.4: Learn about crystallography and to infer the environment of formation of minerals.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		

Part B- Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	Crystals: Definition, elements of symmetry, notations-Weiss and miller, space lattice. Morphological classification of crystals into systems and symmetry classes (Holohedral classes). Twinning in crystals. Projections in crystals - spherical, stereoscopic, and gnomonic.	15
II	Pleochroic scheme of minerals. Extinction phenomenon: Extinction angle and its determinations. Interference phenomenon, order of interference colors and figures, Uniaxial and biaxial minerals: optical indicatrix. Optic sign.	15
III	Structure of silicate minerals: neso-, soro-, cyclo-, iono-, phyllo- and tecto-silicates and their bearing on properties of minerals. Study of the following mineral groups/minerals with reference to structure, PT - stability, physical, chemical, and optical properties, and their mode of occurrence: quartz, feldspar, feldspathoid, pyroxene, amphibole, olivine, mica, clay minerals, garnet, alumino-silicates, staurolite, epidote, zircon, sphene, zeolite, carbonate, and phosphates.	15
IV	Crystal defects (point, line and planar), Basic concepts of mineral stability with emphasis on solid solution, exsolution and ordering. Crystal chemistry involving atomic substitution (simple, coupled) and solid solution between different end members.	15
	Total Contact Hours	60

Chairman
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Kurukshetra-136119.

1159

Suggested Evaluation Methods			
Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**
• Class Participation:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. *An Introduction to the rock forming minerals*, Deer, W.A., Howie, R.A. and Zussman, J., Prentice Hall.
2. *Manual of Mineralogy*, Klein, C. and Hurlbut, Jr.C. S., John Wiley.
3. *Introduction to Mineral Sciences*, Putnis, A., Cambridge University press.
4. *Mineralogical phase equilibria and Pressure-Temperature-Time paths*, Spear,F.S., Mineralogical Society of America Publication.
5. *Optical Mineralogy*, Phillips, W.R. and Griffen, D.T., CBS publishers.
6. *Introduction to crystallography*. Phillips, F.C., Longman Group Publication.
7. *Dana's textbook of Mineralogy*, Ford, W.E., Wiley Eastern.
8. *Rutley's Elements of Mineralogy*, Read, H.H., CBS publishers.
9. *Mineralogy*, Berry, Mason and Dictrich, CBS publishers.
10. *Optical Mineralogy*, Kerr, P.F., McGraw Hill.
11. *Elements of Optical Mineralogy* I & II, Winchell, A.N. Read Books.
12. *Practical Manual of crystal optics*, Babu, S.K. and Sinha, D.K., CBS Publishers.
13. *Mineral optics*, Phillips, R.W., Freeman & Company, USA

Chairman
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1160

Session: 2024-25			
Part A - Introduction			
Name of the Programme	M.Sc. Applied Geology		
Semester	**I**		
Name of the Course	**Geology Lab-I** (Practical based on M24- GGY-101, M24- GGY-102 & Field Work)		
Course Code	M24-GGY-105		
Course Type	PC-1		
Level of the course	400-499		
Pre-requisite for the course (if any)	NIL		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 105.1: Get practical knowledge about fundamental and applied aspects of the petrology, palaeontology, structural geology and surveying. CLO 105.2: Preparation of geological cross sections of basic geological maps. CLO 105.3: Get field exposures where they can identify minerals, rocks, structures & their geological observations. CLO 105.4: Do the basic geological mapping in the field.		
Credits	Theory	Practical	Total
	0	4	4
Teaching Hours per week	0	8	8
Internal Assessment Marks	0	30	30
End Term Exam Marks	0	70	70
Max. Marks	0	100	100
Examination Time	0	4 hours (or as decided by PGBOS)	

Part B- Contents of the Course

	Practicals	Contact Hours
1.	Megascopic properties of important rocks in hand specimen.	120
2.	Elementary exercises relevant to recognition of folds, faults and unconformities on maps and in models. Preparation of geological cross sections from Geological Maps.	
3.	Megascopic study of important fossils. Study of important stratigraphic rocks in relation to Geological time and mineral deposits.	
4	Preparation of site plans with the help of chain, tape and plane table. Profiling using dumpy level and determination of height using theodolite. Use of field instruments viz., clinometer, brunton, prismatic compass, abney level, altimeter and pedometer. Study of Toposheets, contour maps and total station.	
5.	The following activities will be performed by the students during about one-week Geological Field work and have to submit Field Work Report. a) Sampling. b) Identification of Minerals, Rocks and Structures. c) Preparation of Geological Maps. d) Measurement of Structural Features. e) And other Geological observations.	

Suggested Evaluation Methods			
Internal Assessment: 30		**End Term Examination: 70**	
➢ **Practicum**	**30**	➢ **Practicum**	**70**
• Class Participation:	5	Lab record, Viva-Voce, write-up, execution of the practical, Field work and Field Report.	
• Seminar/Demonstration/Viva-voce/Lab records etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. *An Outline of Structural Geology*, Hobbs, M B.E., Means, W.D. and Williams, P.F., John Wiley & Sons.
2. *Ore Deposits of India*, Gokhale and Rao, Thomson Press, Delhi.
3. *Rutley's Elements of Mineralogy*, Read, H.H., Springer.
4. *Surveying Volume I*, Punmia, B.C. and Jain, A., Laxmi publications (P) Ltd.
5. *Surveying Volume 2*, Punmia, B.C., Laxmi Publications (P) Ltd.
6. *India's Mineral Resources*, Krishnaswami S., New Delhi, Oxford and IBH Pub. Co.
7. *A Handbook of minerals, Crystals, Rocks and Ores*, Parmod, A.O., New India Publishing Agency.
8. *Field Geology*, Lahee, F. H., CBS Publisher.
9. *Introduction To Geological Structures and Maps,* George M. Bennison, Routledge.

Chairman
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1162

Session: 2024-25

Part A - Introduction

Name of the Programme	M.Sc. Applied Geology
Semester	I
Name of the Course	**Geology Lab-II** (Practical based on M24- GGY-103 & M24- GGY-104)
Course Code	M24-GGY-106
Course Type	PC-2
Level of the course	400-499
Pre-requisite for the course (if any)	NIL
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 106.1: Gain the practical knowledge about the Physics and Chemistry of the Earth. CLO 106.2: Study and interpret geochemical and geophysical data. CLO 106.3: Understand crystal systems, study of optical properties of various mineral groups, megascopic study of minerals and ore minerals. CLO 106.4: Identify and classify minerals and ore minerals.

	Theory	Practical	Total
Credits	0	4	4
Teaching Hours per week	0	8	8
Internal Assessment Marks	0	30	30
End Term Exam Marks	0	70	70
Max. Marks	0	100	100
Examination Time	0	4 hours (or as decided by PGBOS)	

Part B- Contents of the Course

	Practicals	**Contact Hours**
1.	Study and interpretation of geochemical data.	120
2.	To draw the internal structure of the Earth, and to demarcate the boundaries of crust, mantle and core.	
3.	To draw the seismic maps of India by free hand and its interpretations in context of the geotectonic.	
4.	To draw the tectonic evolution map of Himalaya and explain its different tectonic divisions.	
5.	Understanding of crystal systems by using geological models.	
6.	Identification of physical properties of different minerals and to categorized them in groups.	
7.	Identification of optical properties of various minerals in plane polarized and crossed nicols.	

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
➢ **Practicum**	**30**	➢ **Practicum**	**70**
• Class Participation:	5	Lab record, Viva-Voce, write-up and execution of the practical	
• Seminar/Demonstration/Viva-voce/Lab records etc.:	10		
• Mid-Term Exam:	15		

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1163

Part C-Learning Resources

1. *Understanding Earth*, Gauss, I.G., Smith, P.S. and Wilson, R.G.L., MIT Press.
2. *The Dynamic earth - A textbook in Geosciences*, Wyllie, P.J., Wiley.
3. *Physics and Geology*, Jacobs, J.J., Russel, R.D. and Wilson, J.T., McGraw Hill.
4. *Fundamental of Geodynamics*, Schiedegger, A.E., Springer.
5. *An Introduction to the rock forming minerals,* Deer, W.A., Howie, R.A. and Zussman, J. Longman., Prentice Hall.
6. *Manual of Mineralogy*, Klein, C. and Hurlbut, Jr. C.S., John Wiley.
7. *Introduction to Mineral Sciences*, Putnis, A., Cambridge University press.
8. *Optical Mineralogy,* Phillips, W.R. and Griffen, D.T., CBS publishers.
9. *Laboratory handbook of petrographic techniques*, Hutchinson, C.S., John Wiley.

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Session: 2024-25	
Name of the Programme	M.Sc. Applied Geology
Semester	**I**
Name of the Course	**Seminar**
Course Code	M24-GGY-107
Course Type: (CC/DEC/PC/Seminar/CHM/OEC/EEC)	Seminar
Level of the course	400-499
Course Learning Outcomes(CLO) After completing this course, the learner will be able to:	CLO 107.1: Prepare the power point presentation in an effective manner and to improve presentation skill. CLO 107.2: Improve communication skills and also discussion and questioning during the presentation will boost the knowledge and confidence level.
Credits	Seminar
	2
Teaching Hours per week	2
Max. Marks	50
Internal Assessment Marks	0
End Term Exam Marks	50
Examination Time	1 hour
Instructions for Examiner: Evaluation of the seminar will be done by the internal examiner(s) on the parameters as decided by staff council of the department. There will be no external examination/viva-voce examination.	

Chairman
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Session: 2024-25			
Part A - Introduction			
Name of Programme	M.Sc. Applied Geology		
Semester	**II**		
Name of the Course	**Palaeontology and Stratigraphy**		
Course Code	M24- GGY-201		
Course Type	CC-5		
Level of the course	400-499		
Pre-requisite for the course (if any)	NIL		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 201.1: Understand different types of fossils and their various uses to mankind. CLO 201.2: Get to know about the geological time scale and stratigraphic division of India CLO 201.3: Provide knowledge regarding various types of deposits of ores, petroleum and coal, their distribution and usefulness to mankind. CLO 201.4: Understand the basics and importance of sustainable development and environmental geology to society.		
Credits	Theory	Practical	Total
Teaching Hours per week	4	0	4
Internal Assessment Marks	4	0	4
End Term Exam Marks	30	0	30
Max. Marks	70	0	70
Examination Time	100	0	100
	3 hours		

Part B- Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	Vertebrate Palaeontology: Evolution of horse, elephant and man. Invertebrate Palaeontology: Functional morphology and geological history of Brachiopods, Mollusca, Trilobites, Echinoderms and Graptolites. Palaeobotany: General classification of plant kingdom, morphology and classification of Gondwana flora.	15
II	Micropalaeontology: Sampling and sample preparation techniques for microfossils. Morphology, classification, ecology and stratigraphic distribution of Ostracoda, Foraminifera, Conodonts, Radiolarians, Silicoflagellates, and Chitinozoans. Palynology, morphology of Spores and pollen. Application of Microfossils.	15
III	Code of stratigraphic nomenclature, stratigraphic correlation, cyclo-stratigraphy, pedo-stratigraphy, brief introduction to the concepts of sequence stratigraphy. Precambrian Stratigraphy: Dharwar, Cuddapah, Vindhyan and Delhi supergroups.	15

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1166

IV	Paleozoic stratigraphy: Spiti and Kashmir. Mesozoic Stratigraphy: Gondwana Supergroup, Deccan Traps, Triassic of Spiti, Jurassic of Kutch, Cretaceous of Trichinopoly. Mesozoic stratigraphy (Spiti, Kutch, and Narmada Valley. Cenozoic stratigraphy of Shimla Himalayas: Siwaliks, Subathu, Dagshai and Kasauli. Indo Gangetic alluvial plains.	15
	Total Contact Hours	60

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**
• Class Participation:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. *Palaeontology*, Jain, P.C. and Anantharaman, M.S., Vishal Publishing Co.
2. *Essentials of paleobotany*. Shukla, A. C., & Misra, S. P., Vikas Publisher.
3. *Invertebrate Palaeontology and Evolution*, Clarkson, E.N.K., Blackwell.
4. *Palaeontology- The record of life*, Stearn, C.W. & Carroll, R.L., John Wiley.
5. *Bringing Fossils to Life- An introduction to Palaeobiology*, Prothero, D.R., McGraw Hill.
6. *Foraminifera*, Haynes, J.R., John Wiley.
7. *Elements of Micropalaeontology*, Bignot, G., Graham and Trotman, Springer.
8. *Introduction to Microfossils*, Jones, D.J., Hafner Publishing Co Ltd.
9. *Microfossils*, Brasier, M. and Armstrong, H., Wiley Blackwell.
10. *Invertebrate Fossils*, Moore, Lalicker and Fischer, McGraw Hill.
11. *Principles of Invertebrate Palaeontology*, Shrock and Twenoffel, CBS Publishers.
12. *Essentials of Palynology*, Nair, P.K.K., Asia Pub. House.
13. *Palaeontology Invertebrate*, Woods, H., CBS Publishers.
14. *Vertebrate Palaeontology*, Ramer, A.S., Univ. of Chicago Press.
15. *Precambrian Geology: The Dynamic Evolution of Continental Crust*, Goodwin, A.M., Academic Press.
16. *Principles of Sedimentology and Stratigraphy*, Boggs, Sam Jr., Prentice Hall.
17. *Precambrian Geology of India*, Naqvi, S.M. and Rogers, J.J.W., Oxford Univ. Press.
18. *Geology of India and Burma*, Krishnan, M. S., CBS Publishers.
19. *Geology of India*, Wadia, D.N., Alpha Edition.
20. *Fundamental of Historical Geology and Stratigraphy*, Kumar Ravinder., New Age International Publishers.
21. https://egyankosh.ac.in/bitstream/123456789/69603/1/Block-2.pdf
22. https://epgp.inflibnet.ac.in/epgpdata/uploads/epgp_content/S000014ER/P000274/M027511/ET/1519204012paper4module_37_etext.pdf

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Session: 2024-25			
Part A - Introduction			
Name of Programme	M.Sc. Applied Geology		
Semester	**II**		
Name of the Course	**Structural Geology and Tectonics**		
Course Code	M24-GGY-202		
Course Type	CC-6		
Level of the course	400-499		
Pre-requisite for the course (if any)	Nil		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 202.1: Learn the concept and tectonics of deformation structures. CLO 202.2: Know the Kinematics of deformed structures and its significance. CLO 202.3: Learn the concept of petrofabric analysis and relationship between crystallization and deformation. CLO 202.4: Understand Himalayan Orogeny, various Map projections and its applicability in field and to the society.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		

Part B- Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	Mechanical principles and properties of rocks and their controlling factors. Theory of rock failure. Concept of stress and strain and their relationships of elastic, plastic and viscous materials. Strain markers in naturally deformed rocks. Behavior of minerals and rocks under deformation.	15
II	Fold: mechanics of folding and buckling. Fractures and joints: their nomenclature, age relationship, origin and significance. Causes and dynamics of faulting. Strike-slip faults, normal faults, reverse faults and thrusts, overthrust, nappe, klippe and window. Planar and linear fabrics in deformed rocks, classification and significance. Structural behavior of diapirs and salt domes.	15
III	Concept of petro-fabrics and symmetry: objective, field and laboratory techniques. Types of fabrics. Time relationship between crystallization and deformation.	15
IV	Major tectonic division of Himalaya. Collision of India with Asia. Evolution of Volcanic Island Arc. Indus-Suture Zone. Emergence and evolution of Himalaya. Orogeny, Fore arc basin and Back arc basin. Study	15

Chairman
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Kurukshetra-136119. 1168

	of stereographic projection.	
	Total Contact Hours	60

Suggested Evaluation Methods			
Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**
• Class Participation:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. *Folding and Fracturing of Rocks*, Ramsay, J.G., McGraw Hill.
2. *An outline of Structural Geology*, Hobbs, B.E., Means, W.D. and Williams, P.F., John Wiley.
3. *Structural Geology of Rocks and Region*, Davis, G.R., John Wiley.
4. *Modern Structural Geology, Volume I & II*, Ramsay, J.G. and Hubber, M.I., Academic Press.
5. *Analysis of Geological Structures*, Price, N.J. and Cosgrove, J.W., Cambridge Univ. Press.
6. *Structural Geology Fundamentals of Modern Developments*, Ghosh, S.K., Pergamon Press.
7. *Geological Structures and Moving Plates*, Park, R.G., Springer science + Business Media Dordrecht.
8. *Global Tectonics*, Keary, P. and Vine, F.J., Blackwell.
9. *Dynamic Himalaya*, Valdiya, K.S., Universities press, Hyderabad.
10. *Geomorphology and Global Tectonics*, Summerfield, M.A., Springer Verlag.
11. *Mechanics in Structural Geology*, Bayly, B., Springer Verlag.
12. *Micro-tectonics*, Passchier, C.W. and Trouw, R.A.J., Springer Berlin, Heidelberg.
13. *Aspects of Tectonics: Focus on South-Central Asia*, Valdiya, K.S., Tata Mc Graw Hill Pub. Co.

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Session: 2024-25			
Part A - Introduction			
Name of Programme	M.Sc. Applied Geology		
Semester	**II**		
Name of the Course	**Environmental Geology**		
Course Code	M24-GGY-203		
Course Type	CC-7		
Level of the course	400-499		
Pre-requisite for the course (if any)	NIL		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 203.1: Understand ecology and their inter-relationship with mankind. CLO 203.2: Learn about water quality and waste management. CLO 203.3: Get knowledge regarding Natural resources and their conservation. CLO 203.4: Comprehend environmental impact assessment and knowledge of environmental laws.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		

Part B-Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	Components of environment, ecology and ecosystem. Interactions between atmosphere, hydrosphere, lithosphere, biosphere and man. Principles of environmental geology and ethics of conservation. Atmosphere: Increasing trend of CO_2 and other greenhouse gases. Fossil fuel burning, ozone layer depletion and global warming. Smog pollution, acid rains, causes and remedies. Other causes of pollution.	15
II	Hydrologic cycle and Earth's water balance. Pollution of surface and subsurface water. Water quality criteria for domestic and industrial use. Water quality degradation due to use of fertilizers, pesticides and geo-genic causes. Hydro-geologic considerations for liquid waste disposal. Hydrologic implications of solid waste disposals. Waste (solid, liquid, gases) management and control.	15
III	Natural resources of Earth and their depletion. Land degradation due to natural hazards. Land conservation and land use planning. Watershed management, impact of irrigation - water logging and soil degradation. Energy minerals and their conservation, non-conventional sources of energy,	15

Chairman
Department of Geology,
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Kurukshetra-136119.

1170

	nuclear waste and its disposal.	
IV	Types of microorganisms. Role of sulfur, nitrogen and iron bacteria in the environment. Biogeochemistry of iron, manganese and sulfur. Marine pollution- causes and controls. Environmental impact assessment – impact of mining on environment, environmental health and environmental law in India.	15
	Total Contact Hours	60

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**
• Class Participation:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. *Environmental geology*, Lindgren, L., Prentice Hall.
2. *Environmental geology*, Keller, E. A., Pearson.
3. *Organic micro-pollutants in the aquatic environment*, Angeletti, G., Springer Science Business Media.
4. *Environmental Geoscience: Interaction between natural systems and man*, Strahler, A. N. and Strahler, A. H., John Wiley and Sons Inc.
5. *Water pollution*, Tripathi, A. K. and Panday, S. N., CBS publishers.

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Session: 2024-25			
Part A - Introduction			
Name of Programme	M.Sc. Applied Geology		
Semester	**II**		
Name of the Course	**Sedimentology and Geomorphology**		
Course Code	M24-GGY-204		
Course Type	CC-8		
Level of the course	400-499		
Pre-requisite for the course (if any)	NIL		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 204.1: Understand sedimentary rocks, structures, environments of sedimentation and sedimentary facies in nature. CLO 204.2: Understand characteristics of various sedimentary environments and palaeo-current analysis. CLO 204.3: Know about Field and laboratory methods to study and analyze sedimentary rocks. CLO 204.4: Know about Fundamental concepts of geomorphology and their application in society.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		

Part B- Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	Concept of size, size classification of sedimentary aggregates, causal factors of grain size distribution: provenance, transportation and depositional processes, shape, roundness, porosity and permeability. Sedimentary structures. Maturity of sediments: lithification and diagenesis. Facies.	15
II	Conglomerate types: ortho, para, intraformational. Sandstone types: feldspathic and arkose, lithic, wackes and quartz arenites. Shales and clays. Classification of sandstones. Sedimentological characteristics of fluvial, glacial and aeolian environments. Provenance of sediments, paleocurrent analysis.	15
III	Size analysis of sediments by sieving method, staining technique, X-ray and DTA analysis of clays, heavy mineral analysis and its significance. Application of sedimentary petrology to science, industry and technology. Active tectonic studies of sedimentary basins. Paleochannels of the ancient Saraswati and Drishadvati river systems and their geological significance.	15

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Kurukshetra-136119

1172

IV	Fundamental concepts of geomorphology, base level erosion and peneplanation, cycle concept, rejuvenation and interruption of geomorphic cycle. Climate and geomorphic processes. Factors governing evolution of landforms. Influence of structure and lithology on drainage. Application of geomorphology in civil engineering and strategic terrain evaluation.	15
	Total Contact Hours	60

Suggested Evaluation Methods			
Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**
• Class Participation:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. *Sedimentary Rocks,* Pettijohn, F.J., CBS publishers.
2. *Depositional Sedimentary Environments,* Reineck and Singh, Springer.
3. *Manual of Sedimentary Petrography,* Krumbein, W.C. and Pettijohn, F.J., D. Appleton Century, New York.
4. *Principles of Sedimentary deposits: Stratigraphy and Sedimentology,* Friedman, Gerald and Sanders, Macmillan USA.
5. *Introduction of Sedimentology,* Shelly, R.C., Academic Press.
6. *Petrography of Sedimentary rocks,* Folk, R.L., Hemphill Pub. Co.
7. *Procedures in Sedimentary environments,* Carver, R.F., New York, Wiley Interscience.
8. *Palaeocurrent and Basin analysis,* Pettijohn and Potter, Springer.
9. *Sedimentology,* Mclane, M., OUP USA.
10. *Petrology of the Sedimentary rocks,* Greensmith, J.T., Springer.
11. *Applications of Sedimentology,* Trask, scholarly article.
12. *Sequence in Layered rocks,* Shrock and Robert, R., McGraw Hill.
13. *Introduction to Sediment analysis,* Rouse, F., Arizona State Univ.
14. *Principles of Geomorphology,* Thornbury, W.D., CBS Publishers.
15. *Introduction to Sedimentology,* Sengupta, S., Oxford and IBH.
16. *Sand and Sandstone,* Pettijohn, F.J., Potter, P.E. and Siever, R., Springer Verlag.
17. *Introduction to Physical Geology,* Dutta, A.K., Kalyani Publishers.
18. *Geomorphology,* Sharma, V.K., Tata McGraw Hill.
19. *A Text Book of Geomorphology,* Worcester, P.G., D. Van Nostrand Co.
20. *Fundamentals of Geomorphology,* Rice, R.J., Longman.
21. *An Introduction to Physical Geology,* Miller, W.J., D. Van Nostrand Co.
22. *An outline of Geomorphology: the physical basis of geography,* Morgan, R.S. and Wooldridge, S.W., Orient Longman Limited.
23. *Introduction to Marine Geology and Geomorphology,* King, A.M.C., Hodder and Stoughton Educational.
24. *Principles of Physical sedimentation,* Allen, J.R.L., The Blackburn Press and Springer.
25. *Earth Surface Processes,* Allen, P., Wiley-Blackwell.
26. *Sedimentology and Stratigraphy,* Nichols, G., Wiley India Pvt. Ltd.
27. *Sedimentary Environments,* Readings, H.G., Wiley-Blackwell.
28. *Depositional Systems,* Davis, R.A., Pearson College Div.
29. *Sedimentary Basins: Evolution, Facies and Sediment budget,* Einsele, G., Springer- Verlag.
30. *Sedimentary Geology,* Prothero, D.R. and Schwab, F., W.H. Freeman.

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Session: 2024-25			
Part A - Introduction			
Name of the Programme	M.Sc. Applied Geology		
Semester	**II**		
Name of the Course	**Geology Lab-III** (Practical based on M24- GGY-201 & M24- GGY-202)		
Course Code	M24-GGY-205		
Course Type	PC-3		
Level of the course	400-499		
Pre-requisite for the course (if any)			
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 205.1: Study vertebrate, invertebrate, and plant fossils. CLO 205.2: Determine the order of geologic events, delineate environmental conditions on the basis of fossil assemblages. CLO 205.3: Preparation of geological cross sections of horizontal, dipping, folded and faulted structures. Interpretation of simple and complex geological maps and sections. CLO 205.4: Deal with structural geological problems concerning economic mineral deposits and. Students will be able to apply it in the field in geo-scientific projects professionally. Students will also be able to study tectonic features of the Earth especially the Himalayas.		
Credits	Theory	Practical	Total
	0	4	4
Teaching Hours per week	0	8	8
Internal Assessment Marks	0	30	30
End Term Exam Marks	0	70	70
Max. Marks	0	100	100
Examination Time	0	4 hours (or as decided by PGBOS)	

Part B- Contents of the Course

	Practicals	**Contact Hours**
1.	Study of rocks from different stratigraphic horizons. Exercises on stratigraphic correlation. To determine the order of geologic events. Study of vertebrate, invertebrate, and plant fossils.	120
2.	Processing of samples, picking and mounting of fauna. Identification and morphological study of the microfossils under microscope. Delineation of environmental conditions on the basis of fossil assemblages.	
3.	Preparation of geological cross sections from different structural geological maps. Preparation and interpretation of geological map and section.	
4.	Structural problems concerning economic mineral deposits.	
5.	Plotting and interpretation of petro-fabric data and resultant diagrams, Study of large-scale tectonic features of the earth. Kinematic analysis of discontinuous planes using stereographic projection.	

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
➢ **Practicum**	**30**	➢ **Practicum**	**70**
• Class Participation:	5		

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1174

• Seminar/Demonstration/Viva-voce/Lab records etc.:	10	Lab record, Viva-Voce, write-up and execution of the practical
• Mid-Term Exam:	15	

Part C-Learning Resources

1. *Folding and fracturing of rocks*, Ramsay, J.G., McGraw Hill.
2. *An outline of Structural Geology*, Hobbs, B.E., Means, W.D. and Williams, P.F., John Wiley.
3. *Structural Geology of rocks and region*, Davis, G.R., John Wiley.
4. *Modern Structural Geology, Volume I & II*, Ramsay, J.G. and Hubber, M.I., Academic Press
5. *Analysis of geological structures*, Price, N.J. and Cosgrove, J.W., Cambridge Univ. Press.
6. *Structural Geology fundamentals of modern developments*, Ghosh, S.K., Pregamon Press.
7. *Global tectonics*, Keary, P. and Vine, F.J., Blackwell.
8. *Palaeontology,* Jain, P.C. and Anantharaman, M.S., Vishal Publishing Co.
9. *Essentials of paleobotany.* Shukla, A. C., & Misra, S. P., Vikas, Publisher.
10. *Invertebrate Palaeontology and Evolution*, Clarkson, E.N.K., Blackwell.
11. *Microfossils*, Brasier, M. and Armstrong, H., Wiley Blackwell.
12. *Invertebrate Fossils*, Moore, Lalicker and Fischer, McGraw Hill
13. *Vertebrate Palaeontol*ogy, Ramer, A.S., Univ. of Chicago Press.
14. *Precambrian Geology: The Dynamic Evolution of Continental Crust*, Goodwin, A.M., Academic Press.
15. *Principles of Sedimentology and Stratigraphy*, Boggs, Sam Jr., Prentice Hall.
16. *Geology of India and Burma*, Krishnan, M. S., CBS Publishers.
17. *Geology of India*, Wadia, D.N., Alpha Edition.
18. https://egyankosh.ac.in/bitstream/123456789/69603/1/Block-2.pdf

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Session: 2024-25			
Part A - Introduction			
Name of the Programme	M.Sc. Applied Geology		
Semester	**II**		
Name of the Course	**Geology Lab-IV** (Practical based on M24- GGY-203 & M24- GGY-204)		
Course Code	M24-GGY-206		
Course Type	PC-4		
Level of the course	400-499		
Pre-requisite for the course (if any)	NIL		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO 1: Study the environmental geological parameters for the conservation and management of the Earth's resources, and to study geological factors and suggest adequate waste disposal sites and management practices. CLO 2: Gain practical knowledge regarding the assessment of air, water and soil pollution and will be able to apply it in the field in geo-scientific projects professionally. CLO 3: Understand the diagenetic and depositional features of sedimentary rocks along with sedimentological and paleo-current interpretations. CLO 4: Study different landforms, other geomorphological features and its applications in other geological studies.		
Credits	Theory	Practical	Total
	0	4	4
Teaching Hours per week	0	8	8
Internal Assessment Marks	0	30	30
End Term Exam Marks	0	70	70
Max. Marks	0	100	100
Examination Time	0	4 hours (or as decided by PGBOS)	
Part B-Contents of the Course			
Practicals			**Contact Hours**

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Kurukshetra-136119.

1176

1.	Preparation of ecological maps and their interpretation.	120
2.	Evaluation of water quality criteria for potable, domestic, industrial, irrigation and waste water.	
3.	Evaluation of environmental impact of air pollution.	
4.	Numerical and case studies on groundwater pollution, land degradation and landslide assessment.	
5.	Study of primary, secondary and biogenic sedimentary structures in hand specimens, in photographic atlases, field photographs and wherever possible on the outcrops.	
6.	Analysis and interpretation of depositional sedimentary environments using actual case histories from the Indian stratigraphic records.	
7.	Megascopic and microscopic study of clastic, chemical sedimentary rocks and detailed study of diagenetic features in thin sections.	
8.	Microscopic study of heavy minerals and exercises on mineralogical and geochemical data plots for environmental interpretations.	
9.	Interpretation of different sedimentological characteristics from size data, roundness and sphericity analysis.	
10.	Paleo-current data interpretation and geomorphological analysis from maps and toposheets.	

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
➢ **Practicum**	**30**	➢ **Practicum**	**70**
• Class Participation:	5	Lab record, Viva-Voce, write-up and execution of the practical	
• Seminar/Demonstration/Viva-voce/Lab records etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. *Sedimentary Rocks*, Pettijohn, F.J., CBS publishers.
2. *Palaeocurrent and Basin analysis*, Pettijohn and Potter, Springer.
3. *Introduction to Sedimentology*, Sengupta, S., Oxford and IBH.
4. *Environmental geology*, Lindgren, L., Prentice Hall.
5. *Water pollution*, Tripathi, A. K. and Panday, S. N., CBS publishers.

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Scheme of Examination
for
Post Graduate Programme

M.Sc. MICROBIOLOGY

as per NEP 2020
Curriculum and Credit Framework for Postgraduate Programme

With Multiple Entry-Exit, Internship and CBCS-LOCF
With effect from the session 2024-25 (in phased manner)

DEPARTMENT OF MICROBIOLOGY
FACULTY OF LIFE SCIENCES

KURUKSHETRA UNIVERSITY, KURUKSHETRA -136119
HARYANA, INDIA

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49 (1178)

KURUKSHETRA UNIVERSITY, KURUKSHETRA

Scheme of Examination for Postgraduate Programme Microbiology
as per NEP 2020 Curriculum and Credit Framework for Postgraduate Programme
(CBCS LOCF) with effect from the session 2024-25 (in phased manner)

Semester	Course Type	Course Code	Nomenclature of Course	Theory (T) / Practical (P)	Credits		Contact hours per week L: Lecture P: Practical S: Seminar				Internal Assessment Marks	End Term Examination Marks	Total Marks	Examination hours
						Total	L	S	P	Total				
1	CC-1	M24-MIC-101	Diversity of Prokaryotic & Eukaryotic microbes	T	4	26	4	0	0	4	30	70	100	3
	CC-2	M24-MIC-102	Microbial Genetics	T	4		4	0	0	4	30	70	100	3
	CC-3	M24-MIC-103	Microbial and analytical techniques	T	4		4	0	0	4	30	70	100	3
	CC-4	M24-MIC-104	Microbial biochemistry and metabolism	T	4		4	0	0	4	30	70	100	3
	PC-1	M24-MIC-105	Practical based on Papers M24-MIC-101 & M24-MIC-102	P	4		0	0	8	8	30	70	100	4
	PC-2	M24-MIC-106	Practical based on Papers M24-MIC-103 & M24-MIC-104	P	4		0	0	8	8	30	70	100	4
	SEMINAR	M24-MIC-107	Seminar	S	2		0	2	0	2	0	50	50	1
	CC-5	M24-MIC-201	Recombinant DNA Technology	T	4	26	4	0	0	4	30	70	100	3
	CC-6	M24-MIC-202	Molecular Biology	T	4		4	0	0	4	30	70	100	3
	CC-7	M24-MIC-203	Medical Microbiology	T	4		4	0	0	4	30	70	100	3
	CC-8	M24-MIC-204	Biostatistics and computer for biologists	T	4		4	0	0	4	30	70	100	3
	PC-3	M24-MIC-205	Practical based on Papers M24-MIC-201 & M24-MIC-202	P	4		0	0	8	8	30	70	100	4

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	PC-4	M24-MIC-206	Practical based on Papers M24-MIC-203 & M24-MIC-204	P	4		0	0	8	8	30	70	100	4
	CHM	M24-CHM-201	Constitutional, Human and Moral values, and IPR	T	2		2	0	0	2	15	35	50	3
	Internship	M24-INT-200	AN INTERNSHIP COURSE OF 4 CREDITS OF 4-6 WEEKS DURATION DURING SUMMER VACATION AFTER IIND SEMESTER IS TO BE COMPLETED BY EVERY STUDENT. INTERNSHIP CAN BE EITHER FOR ENHANCING THE EMPLOYABILITY OR FOR DEVELOPING THE RESEARCH APTITUDE.								50	50	100	-
3	CC-9	M24-MIC-301	Microbial biotechnology &industrial microbiology-I	T	4	26	4	0	0	4	30	70	100	3
	CC-10	M24-MIC-302	Immunology & Virology	T	4		4	0	0	4	30	70	100	3
	DEC-1 Any one from M24-MIC-303/304/ MOOC course	M24-MIC-303	Environmental Microbiology	T	4		4	0	0	4	30	70	100	3
		M24-MIC-304	Food & Dairy Microbiology	T	4		4	0	0	4	30	70	100	3
		OR A MOOC Course from Swayam Portal of Equal Credits					-	-	-	-	-	-	-	-
	DEC-2 Any one from M24-MIC-305/306/ MOOC course	M24-MIC-305	Agriculture Microbiology	T	4		4	0	0	4	30	70	100	3
		M24-MIC-306	Microbial pathogenesis &Epidemiology	T	4		4	0	0	4	30	70	100	3
		OR A MOOC Course from Swayam Portal of Equal Credits												
	PC-5	M24-MIC-307	Practical based on Papers M24-MIC-301 & M24-MIC-302	P	4		0	0	8	8	30	70	100	4
	PC-6	M24-MIC-308	Practical based on Papers M24-MIC-303/304 & M24-MIC-305 A/306	P	4		0	0	8	8	30	70	100	4
	OEC	FOR MICROBIOLOGY STUDENTS					Course to be opted from the Pool of OEC course other than the ones offered by Microbiology Department							
	OEC (To be offered to the students of other departments)	M24-OEC-332	General and Applied Microbiology	T	2		2	0	0	2	15	35	50	3

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CC-11	M24-MIC-401	Bioinformatics and Computational biology	T	4		4	0	0	4	30	70	100	3
CC-12	M24-MIC-402	Microbial biotechnology &industrial microbiology-II	T	4		4	0	0	4	30	70	100	3
DEC-3 Any one from M24-MIC-403/404/ MOOC course	M24-MIC-403	Microbial Genomics and Proteomics	T	4		4	0	0	4	30	70	100	3
	M24-MIC-404	Bioremediation and Waste Management	T	4		4	0	0	4	30	70	100	3
	OR A MOOC Course from Swayam Portal of Equal Credits												
DEC-4 Any one from M24-MIC-405/406/ MOOC course	M24-MIC-405	Bioentrepreneurship and IPR	T	4	26	4	0	0	4	30	70	100	3
	M24-MIC-406	Clinical and Pharmaceutical Microbiology	T	4		4	0	0	4	30	70	100	3
	OR A MOOC Course from Swayam Portal of Equal Credits												
PC-7	M24-MIC-407	Practical based on Papers M24-MIC-401 to M24-MIC-402	P	4		0	0	8	8	30	70	100	4
PC-8	M24-MIC-408	Practical based on Papers M24-MIC-403/404 to M24-MIC-405/406	P	4		0	0	8	8	30	70	100	4
EEC	M24-MIC-409	Entrepreneurship and employability in microbiology	T	2		2	0	0	2	15	35	50	3
OR DISSERTATION* (NOTE: IF A CANDIDATE IS OFFERED DISSERTATION COURSE, THEN HE/SHE WILL ALSO STUDY CC-11, DEC-3, DEC-4 & EEC FROM ABOVE COURSES OF SEMESTER 4)													
CC-11	M24-MIC-401	Bioinformatics and Computational biology	T	4		4	0	0	4	30	70	100	3
DEC-3 Any one from M24-MIC-403/404/ MOOC course	M24-MIC-403	Microbial Genomics and Proteomics	T	4		4	0	0	4	30	70	100	3
	M24-MIC-404	Bioremediation and Waste Management	T	4		4	0	0	4	30	70	100	3
	OR A MOOC Course from Swayam Portal of Equal Credits												

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KURUKSHETRA-136119.

DEC-4 **Any one from M24-MIC-405/406/ MOOC course**	**M24-MIC-405**	**Bioentrepreneurship and IPR**	T	4		4	0	0	4	30	70	100	3
	M24-MIC-406	**Clinical and Pharmaceutical Microbiology**	T	4		4	0	0	4	30	70	100	3
	OR A MOOC Course from Swayam Portal of Equal Credits												
EEC	**M24-MIC-409**	**Entrepreneurship and employability in microbiology**	T	2		2	0	0	2	15	35	50	3
Dissertation / Project work	**M24-MIC-410**	**Dissertation/Project Work**	D	12	26	0	0	0	-	0	300	300	
TOTAL CREDITS					**108**	**TOTAL MARKS**						2700	

*Staff Council of the department will decide and declare the number of seats for Dissertation work of 12 Credits in the 4th semester at the beginning of 2nd year depending upon the availability if infrastructure/ faculty and expertise in the area of specialization.

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Programme Learning Outcomes (PLOs) for M.Sc. Microbiology as per NEP-2020

PLOs	Master Degree in Microbiology
	After the completion of Master degree in Microbiology the student will be able to:
PLO-1: Knowledge and Understanding	Demonstrate the fundamental and advanced knowledge of the subject and understanding of recent developments and issues, including methods and techniques, related to the **Microbiology.**
PLO-2: General Skills	Acquire the general skills required for performing and accomplishing the tasks as expected to be done by a skilled professional in the fields of **Microbiology**.
PLO-3: Technical/ Professional Skills	Demonstrate the learning of advanced cognitive technical/professional skills required for completing the specialized tasks related to the profession and for conducting and analyzing the relevant research tasks indifferent domains of the **Microbiology**.
PLO-4: Communication Skills	Effectively communicate the attained skills of the **Microbiology** in well-structured and productive manner to the society at large.
PLO-5: Application of Knowledge and Skills	Apply the acquired knowledge and skills to the problems in the subject area, and to identify and analyze the issues where the attained knowledge and skills can be applied by carrying out research investigations to formulate evidence-based solutions to complex and unpredictable problems associated with the field of **Microbiology** or otherwise.
PLO-6: Critical thinking and Research Aptitude	Attain the capability of critical thinking in intra/inter-disciplinary areas of the **Microbiology** enabling to formulate, synthesize, and articulate issues for designing of research proposals, testing hypotheses, and drawing inferences based on the analysis.
PLO-7: Constitutional, Humanistic, Moral Values and Ethics	Know constitutional, humanistic, moral and ethical values, and intellectual property rights to become a scholar/professional with ingrained values in expanding knowledge for the society, and to avoid unethical practices such as fabrication, falsification or misrepresentation of data or committing plagiarism.
PLO-8: Capabilities/ qualities and mindset	To exercise personal responsibility for the outputs of own work as well as of group/team and for managing complex and challenging work(s) that requires new/strategic approaches.
PLO-9: Employability and job-ready skills	Attain the knowledge and skills required for increasing employment potential, adapting to the future work and responding to the rapidly changing demands of the employers/industry/society with time.

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Kurukshetra University, Kurukshetra

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("A++" Grade, NAAC Accredited)

Syllabus of the Programme
for
Post Graduate Programme

M.Sc. MICROBIOLOGY

as per NEP 2020
Curriculum and Credit Framework for Postgraduate Programme

With Multiple Entry-Exit, Internship and CBCS-LOCF
With effect from the session 2024-25 (in phased manner)

DEPARTMENT OF MICROBIOLOGY
FACULTY OF LIFE SCIENCES

KURUKSHETRA UNIVERSITY, KURUKSHETRA -136119
HARYANA, INDIA

1184

Session: 2024-25			
Part A – Introduction			
Name of Programme	**M.Sc. Microbiology**		
Semester	**1**		
Name of the Course	**Diversity of Prokaryotic & Eukaryotic microbes**		
Course Code	**M24-MIC-101**		
Course Type	**CC-1**		
Level of the course	**400-499**		
Pre-requisite for the course (if any)	**NA**		
Course Learning Outcomes (CLO)	• CLO1. Student will know the history and morphological features of bacteria. • CLO2. Student will be able to general characteristics of bacteria and archaea and specific key features of model archaeal organisms. • CLO3 Students will know how to control the microorganism using different methods and antimicrobial testing. • CLO4. Students will be able to identify the common features of fungi, algae and protozoa.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		

Part B- Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	**History, development ,scope of microbiology:** **Microbial diversity:** Review of classical and current important experimental techniques in microbial taxonomy. Species concept and species evolution, 5-Kingdom classification system, 3-Domain classification system, Prokaryotic and eukaryotic cellular organization, Polyphasic Approach,Use of Bergey's manual (Determinative and Systematic) for microbial identification.Molecular clocks, phylogeny and molecular distances. Phenetic Methods/Chemotaxonomy : Cell wall composition, whole-cell protein, lipid, Isoprenoid quinone, cytochrome, amino acids sequences of various proteins, protein, enzyme profiling, fermentation product profiles, secondary metabolites. Use of Automated systems typing method for identification and classification of microbes. Genotypic Methods : Determination of the DNA base ratio (moles percent), nucleic acid hybridization, DNA-based typing methods • Importance of rRNA in molecular taxonomy : rRNA homology studies, 16S rRNA, 18s rRNA / rDNA fingerprinting, Exploration of Uncultured Microbial Diversity ,Concept of 'unculturable' bacterial diversity •,Strategies for culture of 'unculturable' bacteria • Culture independent molecular methods - PCR dependent approaches versus PCR independent approaches (RFLP, RAPD, ARDRA, DGGE, TGGE, Microarray, FISH, RISA) , Metagenomics- Concepts, work flow, Collection and processing of samples, metagenomic DNA isolation.	15

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1185

II	**Morphological features and arrangement of bacterial cells and Archaea :** Gram-positive and Gram negative bacteria; Extracellular appendages: flagella- arrangement, basic structure and locomotive function; pili- different types, their distribution among bacteria & related functions; fimbriae- occurrence, function and features distinguishing pili and fimbriae; glycocalyxcomposition and role in bacteria; and capsule- microcapsule and slime. Reserve food, pure culture, culture characteristics, isolation; media; maintenance and preservation Bacterial cell wall & cell membrane: Detailed structure of gram negative and gram positive bacterial cell wall, outer membrane lipopolysaccharide (LPS), protoplasts, sphaeroplasts, peptidoglycan sysnthesis, L-forms, cell wall synthesis and its inhibitors including different antibiotics; periplasm; molecular and chemical structure of cell membrane; cytoskeleton including tubulin and actin structural filaments and their role in bacteria. archaea cell, actinomycetes, rickettsia & chlamydia, mycoplasma, spirochetes. General characteristics of archaea; how archea are different from eubacteria; key features of model archaeal organisms: *Halobacterium; Pyrococcus; Sulfolobus;* and *Methanococcus.*	15
III	**Fungi-** Characteristics and classification of fungi. Kirk et al. system of classification. Modes of Reproduction in fungi. Fungi as saprotrophs & their role in decomposition in cellulose, hemicellulose, pectin and lignin. **Algae**- Structure, nutrition and Reproduction in algae. Distribution and classification of algae. Economic importance of Algae as food, Source of agar-agar, alginate, diatomite and iodine etc, antibiotics from algae, use in fisheries and malaria control, as pollution indicator. Algae as photobioreactor. **Virus structure:** Viral morphology, life cycle, virus cultivation **Protozoa**- Morphology, reproduction, modes of nutrition, modes of transmission, locomotory organelles, encystment, excystment.	15
IV	**Control of microorganisms:** physical and chemical methods – Dry heat, moist heat, radiations, osmotic pressure, filtration methods; chemical methods - characteristics of an ideal antimicrobial chemical agent, phenols, alcohols, quaternary ammonium compounds, halogens, heavy metals and their compounds, aldehydes, ethylene oxide and their application. **Antibiotic susceptibility testing**. Mode of action of antibiotics - cephalosporin, chloramphenicol, ciprofloxacin, polymyxin B, sulphonamides. Antimicrobial drug resistance - Mechanism and spread	15
	Total Contact Hours	60

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**
• Class Participation:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Stainier RY, Ingraham JL, Wheelis ML & Palmer PR. General Microbiology, MacMillan.
2. Tortora GJ, Funke BR & Case CL. Microbiology: An introduction with Mastering Microbiology,. Benjamin Cummings.
3. Madigan MT, Martinko JM, Stahl DA & Clark DP. Brock Biology of Microorganisms. Benjamin Cummings
4. Mackie & McCartney Practical Medical Microbiology . Collee JG, Fraser AG, Marmion BP & Simmons A (eds.), Churchill Livingstone, Edinburgh.
5. Atlas RM, Parks LC & Brown AL. Laboratory Manual of Experimental Microbiology. MosbyYear Book, Inc., Missouri.
6. Willey JM, Sherwood LM & Woolverton CJ DA. Prescott, Harley and Klein's Microbiology. McGraw Hill International Edition, USA.
7. Arora DR & Arora B. Medical Parasitology, CBS Publishers, New Delhi.

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Session: 2024-25			
Part A – Introduction			
Name of Programme	**M.Sc. Microbiology**		
Semester	**1**		
Name of the Course	**Microbial Genetics**		
Course Code	**M24-MIC-102**		
Course Type	**CC-2**		
Level of the course	**400-499**		
Pre-requisite for the course (if any)	**NA**		
Course Learning Outcomes (CLO)	CLO 1: It will provide the students a basic appreciation of the underlying principles and practical strategy of the analytical and preparative techniques that are fundamental to study and understanding of life processes. CLO 2: It will make the students to understand the general reactions of various metabolic pathways. CLO 3: Students will be able to explain the principle, working, materials used and applications of various biological techniques that are used to study the basic biological processes. CLO 4: Students will be able to describe the structure and classification of biomolecules.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		

Part B- Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	Essentials of nucleic acid: A brief overview of microbial genetics. Beginning of experimental proof of DNA as genetic material: Transforming principle, Experiments of Griffith, Macleod, Avery, McCarty, Hershey and Chase. RNA as a genetic material. DNA and RNA structure : Xray crystallography, chargaff's rules, phosphodiester bond, glycosidic bond, Watson and crick model of DNA, unusual structures and different types of DNA. Brief account of organization of eukaryotic genomes, packaging of DNA as nucleosomes. DNA denaturation, DNA melting, Tm value, Renaturation kinetics, Cot value, C-value paradox, repetitive DNA. Relaxed DNA, positive and negative supercoiling, overwinding and underwinding and its significance, Topological properties, linking no, twist and writhe, superhelical density, topoisomers, mechanism of action of topoisomerases and DNA gyrase	15
II	Maintenance of Structure of DNA. DNA damage and repair: photoreactivation, base excision repair, nucleotide excision repair, mismatch repair, SOS and error prone repair, and Recombination repair. Mutation : spontaneous and induced mutation, types of point mutation, consequences of point mutation, molecular basis of spontaneous and induced mutation, Base analogues, chemical mutagens, intercalating agent, radiation as mutagens, mutation rate, reversion and suppression, Ames test, significance and harmful effects of mutations. Transposable genetic elements: structure of transposon, IS sequences, bacterial transposon, composite transposon, Tn3 transposon, phage Mu, replication and maturation of Mu DNA, mechanism and significance of transposition: duplication of a target sequences at an insertion sequences, replicative transposition, non replicative transposition, cointegrate as an intermediate in transposition of Tn3.Genetic phenomenon mediated by transposon in bacteria,	15

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KURUKSHETRA-136119.

III	Maintenance of genetic information: Overview of DNA replication: initiation, elongation and termination, unidirectional and bidirectional replication, replication fork, origin of replication. primosomes, replisomes. Enzymology of DNA replication: different types of DNA polymerases, exonuclease , Nick translation and proof reading function. Different modes of DNA replication, rolling circle model of replication,Semiconservative replication , Meselson –Stahl experiment, priming reactions, leading and lagging strand synthesis ,okazaki fragments. Replication in retroviruses. Plasmid replication. Regulation of bacterial chromosome replication. Inhibitors of DNA replication. Relationship between cell cycle and replication. Brief idea of eukaryotic replication	15
IV	Genetic recombination in Bacteria: Horizontal and vertical gene transfer. Bacterial Conjugation: Sex Factor, chromosomal transfer by F+ culture, Hfr , isolation of Hfr strains, F +×F- cross, Hfr transfer, interrupted mating and time of entry mapping genes in bacteria, rate of chromosome transfer, Isolation of F' plasmids, Bacterial Transformation: discovery of transformation, competence, DNA uptake, molecular mechanism of transformation, mapping by transformation. Bacterial Transduction- DNA transfer by phages, lytic and lysogenic cycle, Specialized and generalized transduction. co- transduction and linkage , mapping by cotransduction.	15
	Total Contact Hours	60

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	**Theory**	**70**
• Class Participation:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Maloy SR, Cronan JE Jr. &Freifelder D. Microbial Genetics, 2nd ed., Narosa Publishing House
2.Snyder L &ChampnessW. Molecular Genetics of Bacteria, 3rd ed., ASM Press
3. Gardner JE, Simmons MJ &SnustadDP. Principles of Genetics. John Wiley & Sons
4. Nelson DL & Cox MM.Lehninger's Principles of Biochemistry 5th ed., W.H. Freeman and Company
5. Klug WS and Cummings MR. Essentials of Genetics.Pearson Educational International.
6 Griffiths AJ, Wessler SR,LewontinRC and Carroll SB . Introduction to genetic analysis.W.H.Freeman and Company,New York. 7.Lewin B Gene IX. Jones and Bartlett Publishers.
8. Watson JD Molecular Biology of the Gene 6th edition. Benjamin Cummings.
9. Alberts B *et.al* Molecular Biology of the Cell 5thedition. Garland Science, New York and London.
10. Stryer L Biochemistry 5th edition. W.H. Freeman and Company, USA.

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Session: 2024-25			
Part A – Introduction			
Name of Programme	**M.Sc. Microbiology**		
Semester	**1**		
Name of the Course	**Microbial and analytical techniques**		
Course Code	**M24-MIC-103**		
Course Type	**CC-3**		
Level of the course	**400-499**		
Pre-requisite for the course (if any)	**NA**		
Course Learning Outcomes (CLO)	CLO1. Student will be able to understand the relationship between wavelength, magnification and resolution in various types of microscopy. CLO2. Student will be able to understands the differences between different types of chromatographic and spectroscopic methods CLO3. Students will be familiar with different types of hydrodynamics based separation methods and immobilization methods. CLO4. Students will be able to understand the processes of electrophoresis for separation of macromolecules and applications of radioactivity in biology.		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		

Part B- Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	Microscopy: Basics of microscopy: image formation, magnification, resolution. Wave theory Electromagnetic theory. Principles and working of bright field microscope, fluorescent microscope, phase contrast microscope, electron microscope (SEM & TEM), dark field microscopy. confocal microscopy.Atomic absorption spectroscopy (AAS)Principles of staining. Flow cytometry- flurochromes, fluorescent probe and working principle and its applications	15
II	Chromatography: Gel filtration, ion exchange & affinity chromatography, paper chromatography, Thin Layer Chromatography. Basic principles and biological applications of HPLC and GC. Principles and used of MALDI-TOF and LC-MS platforms. Spectroscopy: Basic concepts, principles and biological applications of different types of spectroscopy: UV, IR, NMR, Raman. X-ray diffraction, circular dichromism for microbiologists.	15
III	Centrifugation: Basics of centrifugation based methods: viscosity, diffusion, sedimentation equilibrium, dialysis, solvent fractionation, centrifugation, Biological applications and interpretations of Density Gradient methods, Ultracentrifugation methods. Methods of bacterial and enzyme immobilization, their advantages and applications. Basics of Radioactive isotopes and radioactive decay, sample preparation, counting, Safety precautions during handling, biological applications	15

Chairman,
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Kurukshetra University,
KURUKSHETRA-136119

1189

IV	PAGE: Polyacrylamide gel electrophoresis (PAGE), native PAGE, SDS-PAGE, 2D electrophoresis, iso electric. Types of Agarose gel electrophoresis. Protein engineering and proteome analysis: Proteome analysis by 2D gel electrophoresis coupled to mass spectrometric analysis. PMF verses MS/MS. Protein arrays and their applications. DNA Microarray and its applications. Methods to study gene function: Gene silencing and gene knockout.	15
	Total Contact Hours	60

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**
• Class Participation:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Freifelder D. Physical biochemistry, Freeman Company.
2. Wilson K & Walker J. Principles and Techniques of Biochemistry and Molecular Biology, 6th ed., Cambridge University Press.
3. Sheehan D. Physical Biochemistry: Principles and Applicatons, John Wiley & Sons Ltd, Chichester, England.
4. Upadhyay, Upadhyay & Nath. Biophysical chemistry. Himalaya Publishing house.
5. Valeur B. Molecular Fluorescence: principles and Applications. 2nd edition. Wiley.
6. Govil G and Hosur RV. NMR – Conformation of Biological Molecules. 1st edition. SpringerVerlag.

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Session: 2024-25	
Part A – Introduction	
Name of Programme	**M.Sc. Microbiology**
Semester	**1**
Name of the Course	**Microbial biochemistry and metabolism**
Course Code	**M24-MIC-104**
Course Type	**CC-4**
Level of the course	**400-499**
Pre-requisite for the course (if any)	**NA**
Course Learning Outcomes (CLO)	CLO1. Students will be acquainted with methods of measuring microbial growth, growth kinetic parameters. Students will gain in-depth knowledge of primary, secondary and group translocation transport systems along with intracellular signaling in bacteria in response to various nutritional and physiological stresses. CLO2.Students will have basic ideas of structure and functions of different macromolecules. Students will have learnt basic concepts of enzyme biochemistry, its kinetics and regulation. CLO3. Students will gather understanding of inorganic and organic nitrogen assimilation and its regulation. Students will understand details of lipid and nucleotide metabolism in E. coli and yeasts. CLO4. Student will learnt central metabolic pathways for carbon metabolism in bacteria. Students will also have brief ideas about bacterial photosynthesis, sulphur metabolism, methanogenesis.

Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		

Part B- Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	Structure and classification of macromolecules:, carbohydrates, Proteins ,lipids and nucleic acids . **Carbohydrate Chemistry and Metabolism:** Carbohydrates chemistry, Metabolites-primary, secondary and precursor. Glycolysis and gluconeogenesis and its Regulation; Pentose phosphate pathway; Glycogen synthesis and breakdown and its regulation; TCA cycle and its regulation, and its role in energy generation; Glyoxylate cycle; Entner-Doudoroff Pathway Co-metabolism of pentoses and hexoses **Metabolism of lipids and nucleotides:** Biosynthesis and degradation of lipids and its regulation in *E. coli*, lipid accumulation in yeast. Nucleic acid chemistry :Purine and pyrimidine biosynthesis, deoxyribonucleotide synthesis, regulation of purine and pyrimidine biosynthesis, inhibitors of nucleotide biosynthesis	15
II	**Amino Acids, Peptides, and Proteins**- Chemistry, structure and Metabolism: Structure and function of amino acids, General reaction of amino acid and Stickland reaction, Amino acid synthesis and breakdown, urea cycle and biological amines,biological N2 fixation ,Inorganic nitrogen assimilation- nitrate and ammonia assimilation, regulation of glutamate synthetase,.Glutathione: distribution in bacteria, biosynthesis and role in redox regulation. **Enzymes:** Introduction, classification, activation energy, enzyme kinetics, kinetic parameters, catalytic efficiency, activity units, turnover number. Methods of plotting enzyme kinetics data: Lineweaver –Burk plot, Michaelis Menten equation, saturation kinetics. Isozymes, ribozymes and abzyme, Enzyme inhibition, models and type of inhibition, allosterism and allosteric regulation. Kinetics of single substrate enzyme catalysed Reaction; Kinetics of reversible inhibitions enzyme catalyzed reactions, King and Altman approach to derive two substrate enzyme catalyzed reactions, types of two substrate enzyme catalyzed reactions, : Enzyme purification	15

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III	**Bacterial photosynthesis:** Photosynthetic microorganisms, Photosynthetic pigments and generation of reducing power by cyclic and non-cyclic photophosphorylation, Electron transport chain (ETC) in photosynthetic bacteria, Carbon dioxide fixation pathways. **Respiration:** Aerobic and anaerobic Mitochondrial electron transport chain, structure and function of ATPase (bacterial and mitochondrial), generation and maintenance of proton motive force, oxidative phosphorylation, inhibitors and un-couplers of electrontransport chain and oxidative phosphorylation, Atkinson's energy charge, phosphorylation n potential and its significance, Anaerobic Respiration: Concept ofanaerobic respiration, Brief account of chemolithotrophy oxidized sulfure compounds, and nitrate as electron acceptor with respect to electron transport chain and energy generation, Biochemistry of Methanogens	15
IV	**Growth and cell division:** Bacterial growth and its measurement, growth curve,growth physiology, Factors affecting growth, Batch, continuous, synchronous and diauxic growth., growth yields, growth kinetics, cell division Modes of reproduction. Cultivation of microorganisms. Cell differentiation and sporulation in *Bacillus*. Reserve food material, polyβ hydroxyl butyrate, poly phosphate granules, sulphur inclusions, cyanophycin granules, cell cycles and its control. **Solute Transport:** Introduction, passive, facilitated, active transport, kinetics. Membrane transport proteins: porins and aquaporins, mechanosensitive channels, ABC transporter, group translocation PEP-PTS system, inducer exclusion and expulsion. **Physiological Adaptation and Intracellular signaling:** Introduction to two component system. Response to physiological stress: aerobic-anaerobic shifts- Arc and Fnr system, osmotic homeostasis. Response to nutritional stress: phosphate supply- Pho regulon, and stringent response. Bioluminescence in bacteria.	15
	Total Contact Hours	60

Suggested Evaluation Methods			
Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**
• Class Participation:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Gottschalk G. Bacterial Metabolism, Springer
2. Caldwell DR. Microbial Physiology and Metabolism, 2nd ed., Star
3. Moat AG, Foster JW & Spector MP. Microbial Physiology,4th ed., John Wiley and Sons
4. Nelson DL & Cox MM. Lehninger's Principles of Biochemistry, 5th ed., WH Freeman & Company
5. Berg JR, Tymoczko CZ & Stryer L. Biochemistry, 6th ed., W.H. Freeman and Company
6. Madigan MT, Martinko JM, Stahl DA & Clark DP. Brock Biology of Microorganisms, 13th ed., Benjamin Cummings.
7. Prescott LM, harley JP & Klein DA.Microbiology, McGraw Hill International Edition, USA.
8. Atlas RM, Parks LC & Brown AL. Laboratory Manual of Experimental Microbiology. Mosby-Year Book,Inc., Missouri.
9. Brown AE. Benson's microbiological applications. TataMacGrawHill
10. White D, Drummond J, Fuqua C The Physiology and Biochemistry of Prokaryotes .4th Edition. Oxford University Press
11. Cohen G N Microbial Biochemistry. 2nd Edition. Springer.

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Session: 2024-25			
Part A – Introduction			
Name of the Programme	**M.Sc. Microbiology**		
Semester	**1**		
Name of the Course	**Practical based on Papers M24-MIC-101 & M24-MIC-102**		
Course Code	**M24-MIC-105**		
Course Type	**PC-1**		
Level of the course	**400-499**		
Pre-requisite for the course (if any)	**NA**		
Course Learning Outcomes (CLO)	CLO1. The student will be versed with different sterilization processes and different staining techniques of given microbial isolate. CLO2. The student will learn different techniques for isolation and purification of bacteria, fungi, algae from different sources. CLO3. The student will learn the antimicrobial susceptibility testing and minimal inhibitory concentration (MIC) of an antibiotic. CLO4. The student will be able to perform genetic recombination in bacteria by conjugation, transformation and transduction		
Credits	Theory	Practical	Total
	0	4	4
Teaching Hours per week	0	8	8
Internal Assessment Marks	0	30	30
End Term Exam Marks	0	70	70
Max. Marks	0	100	100
Examination Time	0	4 hours	

Part B- Contents of the Course

Practicals	**Contact Hours**
Course Contents 1. Handling of general microbiological instrumentations (Hot air oven, Laminar air flow, micropipetting, autoclave, weighing balance, pH meter, BOD incubator ,distillation apparatus, centrifuge. 2. Principles of sterilization techniques and their application in microbiology lab 3. Staining techniques: -(a) Simple staining (b) Gram staining (c) Negative staining (d) Endospore staining. (e) Capsule staining 4. Study of different isolation techniques:(a) Pour plate. (b) Spread plate. (c) Streak plate. 5. Standard plate count. 6. Isolation of bacteria, fungi, actinomycetes, algae. 7. Measurement and counting of conidia/spores of a mold. 8. To study antimicrobial susceptibility testing using antibiotic disc: agar well and disc diffusion. 9. Replica plating method: Preparation of master and replica plates. 10.Isolation of antibiotic resistant bacterial population by gradient plate and replica plate method 11. Determination of minimum inhibitory concentration (MIC) of antibiotics 12. Isolation of thermotolerant mutants of a bacterial /yeast culture 13. UV mutagenesis and isolation of mutants by replica plate method 14. Demonstration of genetic recombination in bacteria by conjugation, transformation and transduction	120

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
➢ **Practicum**	**30**	➢ **Practicum**	**70**
• Class Participation:	5	Lab record, Viva-Voce, write-up and execution of the practical	
• Seminar/Demonstration/Viva-voce/Lab records etc.:	10		
• Mid-Term Exam:	15		

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Part C-Learning Resources
Recommended Books/e-resources/LMS: 1. Cappucino JG and Welsh CT. Microbiology: A laboratory manual. 11th edition. Pearson. 2. Thompson DA. Biochemistry Lab Manual. 3rd edition. 3. Segel IH. Biochemical calculations: how to solve mathematical problems in general biochemistry, Wiley, 2nd Edition. 4. Sambrook J & Russell D. Molecular Cloning: A laboratory manual. 4th edition. Cold Spring Harbor laboratory Press. 5. Collee JG, Fraser AG, Marmion BP & Simmons A (eds.). Mackie & McCartney Practical Medical Microbiology. Churchill Livingstone, Edinburgh. 6. Atlas RM, Parks LC & Brown AL. Laboratory Manual of Experimental Microbiology. MosbyYear Book, Inc., Missouri.

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KURUKSHETRA-136119.

Session: 2024-25			
Part A – Introduction			
Name of the Programme	**M.Sc. Microbiology**		
Semester	**1**		
Name of the Course	**Practical based on Papers M24-MIC-103 & M24-MIC-104**		
Course Code	**M24-MIC-106**		
Course Type	**PC-2**		
Level of the course	**400-499**		
Pre-requisite for the course (if any)	**NA**		
Course Learning Outcomes (CLO)	CLO1. The student will be able to determine concentration of sugar and protein in a given sample after drawing a standard curve. CLO2. The student will be able to study the growth rate of bacteria and effect of various parameters like temperature, pH, oxygen, osmotic pressure, heavy metals on bacterial growth. CLO3. The student will be able to extract and analyse different proteins from bacteria through PAGE and SDS PAGE. CLO4. The student will learn different chromatographic techniques for the separation of compounds.		
Credits	Theory	Practical	Total
	0	4	4
Teaching Hours per week	0	8	8
Internal Assessment Marks	0	30	30
End Term Exam Marks	0	70	70
Max. Marks	0	100	100
Examination Time	0	4 hours	

Part B- Contents of the Course

Practicals	**Contact Hours**
Course Contents 1. Preparation of various buffers 2. To perform general test for carbohydrates (DNS, Molisch's, Anthrone Barfoeds, Bials, Mucic, Seliwanoffs) Proteins (Lowry, Biuret). 3. Preparation of growth curve of bacteria. 4. Determination of specific growth rate and generation time of a bacterial culture 5. Effect of temperature, pH, oxygen, osmotic pressure, heavy metals on bacterial growth 6. Determination of thermal death point (TDP) & thermal death time (TDT) of an organism 7. To perform different biochemical test to characterize the bacterial culture 8. Determination of size and motility (hanging drop technique) of given bacterial culture. 8. Isolation of proteins from bacterial culture by ammonium sulphate ppt. and NaCl extraction. 9. Demonstration of PAGE and SDS-PAGE. 10. To study principle and working of spectrophotometer. 11. Demonstration of thin layer chromatography. 12. Demonstration of paper chromatography. 13. Working of compound microscope. 14. Various types of Electroimmunodiffusion.	120

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
➢ **Practicum**	**30**	➢ **Practicum**	**70**
• Class Participation:	5	Lab record, Viva-Voce, write-up and execution of the practical	
• Seminar/Demonstration/Viva-voce/Lab records etc.:	10		
• Mid-Term Exam:	15		

Chairman,
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Kurukshetra University,
KURUKSHETRA-136119.

1195

Part C-Learning Resources
Recommended Books/e-resources/LMS: 1. Cappucino JG and Welsh CT. Microbiology: A laboratory manual. 11th edition. Pearson. 2. Thompson DA. Biochemistry Lab Manual. 3rd edition. 3. Segel IH. Biochemical calculations: how to solve mathematical problems in general biochemistry, Wiley, 2nd Edition. 4. Sambrook J & Russell D. Molecular Cloning: A laboratory manual. 4th edition. Cold Spring Harbor laboratory Press. 5. Collee JG, Fraser AG, Marmion BP & Simmons A (eds.). Mackie & McCartney Practical Medical Microbiology. Churchill Livingstone, Edinburgh. 6. Atlas RM, Parks LC & Brown AL. Laboratory Manual of Experimental Microbiology. MosbyYear Book, Inc., Missouri.

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KURUKSHETRA-136119.

Session: 2024-25	
Name of the Programme	**M.Sc. Microbiology**
Semester	**1**
Name of the Course	Seminar
Course Code	**M24-MIC-107**
Course Type: (CC/DEC/PC/Seminar/CHM/OEC/EEC)	Seminar
Level of the course	400-499
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO1: To enhance the communication skill of students to express the subject effectively during academic and professional discourse and to improve their ability to comprehend, and integrate academic text.
Credits	Seminar
	2
Teaching Hours per week	2
Max. Marks	50
Internal Assessment Marks	0
End Term Exam Marks	50
Examination Time	1 hour
Instructions for Examiner: Evaluation of the seminar will be done by the internal examiner(s) on the parameters decided by staff council of the department. There will be no external examination/viva-voce examination.	

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KURUKSHETRA-136119.

Session: 2024-25				
Part A – Introduction				
Name of Programme	**M.Sc. Microbiology**			
Semester	**2**			
Name of the Course	**Recombinant DNA Technology**			
Course Code	**M24-MIC-201**			
Course Type	**CC-5**			
Level of the course	**400-499**			
Pre-requisite for the course (if any)	**NA**			
Course Learning Outcomes (CLO)	CLO1: Will be familiar with the use of various cloning vectors, and methods of DNA, RNA and protein analysis and various applications of PCR. CLO2. Will be able to understand the methods by which DNA is sequenced and will gain insights into how entire genomes of organisms are sequenced. CLO3. Will have learnt about promoter analyses, the many uses of the reporter genes, and methods to study the transcriptome along with overexpression of proteins. CLO4. Will have learnt about different methods to analyze protein-DNA and protein-protein interactions, protein engineering, and methods for proteome analyses. Will know about the creation of plant and animal transgenics.			
Credits		Theory	Practical	Total
		4	0	4
Teaching Hours per week		4	0	4
Internal Assessment Marks		30	0	30
End Term Exam Marks		70	0	70
Max. Marks		100	0	100
Examination Time		3 hours		

Part B- Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	**Basics of DNA cloning, and methods of DNA and protein analysis:** Simple cloning and cloning using linkers and adaptors. Cloning into various kinds of vectors – plasmids, phages lambda and M13, phagemids, cosmids, P1 phage, PACs, BACs and YACs. Selection and screening of clones. Southern and Northern Blotting. Radiolabelling probes. Isolation and purification of DNA. RFLP analysis. DNA fingerprinting and its application in forensics, in disease diagnosis and in identification of strains. Western Blotting analysis. **Polymerase chain reaction and construction of cDNA and genomic DNA libraries:** Concept of PCR and various thermophilic enzymes used in PCR. Gradient PCR versusTouchdown PCR. Designing primers. Cloning PCR products. Long PCR, Inverse PCR,Vectorette PCR, RT-PCR, 5' and 3' RACE, Real Time PCR using SYBR Green, Scorpion primers and TaqMan probes, MOPAC, Multiplex PCR, Differential Display PCR, RAPD fingerprinting of micro-organisms, Ligation Chain Reaction, Overlap PCR, Rolling Circle Amplification Technology. Vectors used in the construction of cDNA versus genomic DNA libraries. Steps in the construction of cDNA versus genomic DNA libraries. Screening libraries by colony hybridization and colony PCR. Screening expression libraries. Enriching for clones in cDNA libraries by positive selection and subtractive hybridization. Identifying genes in complex genomes by direct selection of cDNA and exon trapping	15

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II	**Genome sequencing:** DNA sequencing by Sanger's method – traditional and cycle sequencing. Physical mapping by restriction fragment fingerprinting of BAC clones and STS mapping. EPCR. Whole genome shotgun sequencing. Clone-by-clone shotgun sequencing of genome – preparation of BAC/YAC library, selection of BACs, subclone library construction, random shotgun phase and finishing phase followed by sequence authentication.	15
III	Transcriptional analysis of gene expression and transcriptomics: Gene expression analysis by Northern Blotting, RT-PCR, EST analysis and the use of reporter genes. Enzymatic and bioluminescent reporters. Reporters used in protein localization and trafficking studies. Promoter analysis – deletion analysis and linker scanning analysis coupled to reporter assays, mapping transcriptional start sites by S1 nuclease mapping, primer extension studies or 5' RACE. Transcriptome analysis by DD-PCR and EST analysis, DNA microarrays (cDNA arrays and oligo arrays), Serial Analysis of Gene Expresion (SAGE), RNA-seq. Overexpression of recombinant proteins: Overexpression and tagging of recombinant proteins in *E.coli*, driven by lac, T7 and Tet-regulatable promoters, Expression in *B. subtilis*. Overexpression systems in *S.cerevisiae*, *P.pastoris*, *S.pombe* and *K.lactis*. Baculovirus overexpression system. Mammalian cell overexpression system.	15
IV	Gel retardation assay, DNA footprinting by DNase I and chemical methods, yeast one-hybrid assay, ChIP- chip, ChIP-seq. Yeast two hybrid, three-hybrid, split hybrids and reverse hybrid. Co-immunoprecipitation, pull-down, far-western. Use of GFP and its variants in FRET analysis, use of BiFC. Phage display. Insertional and deletion mutagenesis. Site directed mutagenesis by conventional and PCR-based methods. **Applications of recombinant DNA technology:** Human protein replacements – insulin, hGH and Factor VIII. Human therapies – TPA, interferon, antisense molecules. Vaccines – Hepatitis B, AIDS, and DNA vaccines. Creating transgenic animals and plants.	15
	Total Contact Hours	60

Suggested Evaluation Methods			
Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**
• Class Participation:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Molecular Biology by D.P. Clarke, N. Pazdernik. 2nd edition. Academic Press.
2. Molecular Cloning: A laboratory manual by J. Sambrook, D. Russell. 4th edition. Cold Spring Harbor laboratory Press.
3. DNA Technology: The Awesome Skill by I. Edward Alcamo. Harcourt Academic Press.
4. Molecular Biology of the Gene by J. Watson, T. Baker, S. Bell, A. Gann, M. Levine, R. Losick. 7th edition. Pearson.
5. Gene Cloning and DNA Analysis: An Introduction by T.A. Brown. 7th edition. WileyBlackwell Publishers.
6. Old & Primrose. Principles of gene manipulation. Blackwell Scientific Publications.
7. Sambrook&Russel. Molecular Cloning, 3rd volume. CSH Press.
8. Genome Analysis. 4th volume. CSH Press.
9. Lewin B. Genes VIII, International Edition, Pearson Education
10. Alberts B, Johnson A, Lewis J, Raff M, Roberts K, & Walter P. Molecular Biology of the Cell, 5th ed., Garland Science Publishing
11. Fritsch J &Maniatis EF. Molecular cloning a laboratory Manual, Cold Spring Harbor Laboratory

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Session: 2024-25			
Part A – Introduction			
Name of Programme	**M.Sc. Microbiology**		
Semester	**2**		
Name of the Course	**Molecular Biology**		
Course Code	**M24-MIC-202**		
Course Type	**CC-6**		
Level of the course	**400-499**		
Pre-requisite for the course (if any)	**NA**		
Course Learning Outcomes (CLO)	CLO1. Student will be able to understand the process of transcription, the first level of gene expression and its regulation. CLO2. Student will be able to understand different events associated with the processing of newly synthesized RNA including the process of RNA interference and RNA editing CLO3. Students will be able to describe translation mechanism in prokaryotes, regulation of translation, and post-translational processing including the significance of genetic code. CLO4. Student will be able to explain positive and negative regulation of gene expression taking examples of lactose, tryptophan and arabinose operon		
Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		

Part B- Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	**Transcription:** History : linking genes and proteins , evidence for mRNA, transcription v/s replication : similiarities and differences. General principle and steps of transcription: basic apparatus , initiation , elongation and termination. Classes of RNA : rRNA, mRNA and tRNA, structure and function . Types of RNA polymerases: prokaryotic and eukaryotic , structure of prokaryotic RNA polymerase, Monocistronic and polycistronic RNA, transcription bubble, structure of promoter, DNA binding assay for promoter finding , Abortive transcription, Regulation of transcription, Alternate sigma factor , rho dependent and independent termination , hairpin structure for termination . Brief idea of transcription in eukaryotes	15
II	**Maturation and processing of RNA:** Primary transcript, coding and non coding RNA, rRNA processing: Methylation and nucleolytic cleavage and ribonucleoproteins (RNPs), tRNA processing : cutting and degradation of tRNA, ribozymes , mRNA processing : poly A tail, capping, introns and its types and exons and their structure, splicing mechanism , transesterification reaction, self splicing and spliceosomes. Alternative poly A site and alternative splicing. RNA editing and RNA interference (RNAi), miRNA. CRISPR-Cas systems for editing, regulating and targeting genomes.	15

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1200

III	**Translation:** Basic features of genetic code: Triplet code, deciphering of genetic code, degeneracy, characteristics of genetic code, variation in different organisms, universality ,wobble hypothesis, significance of genetic code. Central dogma. Basic steps of translation: basic apparatus, initiation, elongation, termination, coupled transcription and translation, aminoacylsite(A site), peptidyl site (P site) and E site , initiation, elongation and termination factors, aminoacyl tRNA synthetases, leader sequences, in vitro translation system. Post translational modifications. Brief idea of translation in eukaryotes.	15
IV	**Regulation of gene expression:** Constitutive and inducible genes, Operon concept, structural genes, promoter, operator ,regulator genes , concept of inducer and repressor ,catabolite repression, Positive and negative regulation, lac, different mutations study of lac operon, trp operon and concept of attenuation and ara operon, stringent response, ppGpp, cAMP as regulatory molecules.	15
	Total Contact Hours	60

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**
• Class Participation:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Maloy SR, Cronan JE & Freifelder D. Microbial Genetics, Jones & Bartlett publishers.
2. Dale JW. Microbial Genetics of bacteria, Jones & Bartlett publishers.
3. Lewin B . Gene XI , Oxford University press.
4. Freifelder D . Molecular Biology Jones and Bartlett Publishers USA
5. Lodish *et al* . Molecular Cell Biology W.H freeman.
6. Maloy SR, Cronan JE Jr. & Freifelder D. Microbial Genetics, 2nd ed., Narosa Publishing House
7. Gardner JE, Simmons MJ &Snustad DP. Principles of Genetics. John Wiley & Sons
8. Nelson DL & Cox MM.Lehninger's Principles of Biochemistry 5th ed., W.H. Freeman and Company
9. Klug WS and Cummings MR. Essentials of Genetics. Pearson Educational International.
10 Griffiths AJ, Wessler SR, Lewontin RC and Carroll SB . Introduction to genetic analysis. W.H. Freeman and Company,New York.
11. Watson JD Molecular Biology of the Gene 6th edition. Benjamin Cummings.
12. Alberts B *et.al* Molecular Biology of the Cell 5thedition. Garland Science, New York and London.
13. Stryer L Biochemistry 5th edition. W.H. Freeman and Company, USA.

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Session: 2024-25	
Part A – Introduction	
Name of Programme	**M.Sc. Microbiology**
Semester	**2**
Name of the Course	**Medical Microbiology**
Course Code	**M24-MIC-203**
Course Type	**CC-7**
Level of the course	**400-499**
Pre-requisite for the course (if any)	**NA**
Course Learning Outcomes (CLO)	CLO1. Student will be able to understand the basics of classical and molecular microbial pathogenicity. CLO2. Student will be able to understand the spread of microbes through body, their strategies and mechanism to cause the damage. CLO3 Students will understand the emergence of new infections as well as various methods of molecular microbial epidemiology. CLO4. Students will be able to understand the various mechanisms of antimicrobial resistance and new rapid diagnostic principles.

Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		

Part B- Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	Significance of Microbiology in Medicine, Classification of medically important microbes, Normal microbial flora of the human body: normal flora of skin, eye, throat, gastrointestinal tract and urogenital tract - Infections- Sources, types – opportunistic, nosocomial and community acquired infections - Mode of transmission, carriers and their types – investigation of epidemic diseases. Host pathogen interaction: Definitions - Infection, Invasion, Pathogen, Pathogenicity, Virulence, Toxigenicity, Carriers and their types, Transmission of infection, Pathophysiologic effects of LPS. Events occurring immediately after the entry of the microorganisms in host in relation to establishment of infections.	15
II	**Medical bacteriology:** Morphological, cultural and biochemical characteristics of and epidemiology, mechanism of bacterial pathogenesis, lab diagnosis, prophylaxis and control of medically important diseases caused by: *Staphylococcus aureus, Group A Streptococci, Corynebacterium diphtheriae, Clostridium tetani, Bacillus anthracis, Leptospira interrogans, Treponema pallidum, Mycobacterium tuberculosis, Escherichia coli, Vibrio cholerae, Niesserriae, Haemophilus influenza, Helicobacter pylori, Pseudomonas and Salmonella.* Brief note on Chlamydia, Rickettsia Mycoplasama, anaerobic bacterial infections, Atypical Mycobacterium, Zoonotic bacterial pathogens, Antibacterial agents: five modes of action with one example each: Inhibitior of nucleic acid synthesis, inhibition of cell wall synthesis, inhibitor of cell membrane function, inhibitors of protein synthesis, inhibitors of metabolism	15

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III	**Medical mycology:** Morphological and cultural characteristics of and epidemiology, mechanism of fungal pathogenesis, lab diagnosis and treatment of medically important diseases caused by: Superficial mycosis – *Tinea versicolor*. Cutaneous mycoses: *Microsporum, Trichophyton*, Epidermophyton. Subcutaneous mycoses: Sporotrichosis, Chromoblastomycosis, Zygomycosis. Systemic Mycoses – *Histoplasma capsulatum, Blastomyces dermatitidis, Cryptococcus neoformans, Coccidioides immitis, Paracoccidioides brasiliensis*. Opportunistic mycoses: *Candidiasis, Cryptococcosis and Aspergillosis*. Antifungal agents: Mechanism of action of Amphotericin B, Griseofulvin	15
IV	**Morphology of, and pathogenesis, laboratory diagnosis and treatment of medically important protozoan diseases caused by**: *Entomoeba histolytica, Giardia lamblia, Trichmonas vaginalis, Plasmodium vivax, Leishmania donovani, Taenia solium, Ascaris lumbricoides, Ancyclostoma duodenale and Wuchereria bancrofti.* **General properties of and epidemiology, pathogenesis, lab diagnosis and treatment of medically important viral diseases caused by:** Influenza viruses, Measles, Mumps, Rubella, Chicken Pox, Hepatitis A,B,C, D and E, Poliomyelitis, HIV, Human Papilloma Virus, Rabies, Yellow fever, Dengue and Japanese Encephalitis viruses. Brief note on oncogenic viruses. Antiviral agents: Mechanism of action of Amantadine, Acyclovir, Azidothymidine	15
	Total Contact Hours	60

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**
• Class Participation:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

- Ananthanarayanan R and Jeyaram Paniker CK. Textbook of Medical Parasitology. 5th Ed. and 8th edition. Jay Pee brother's Medical publisher, Pvt. Ltd., New Delhi. 2004.
- Rajan S. Medical Microbiology. MJP Publishers, Chennai. 2007.
- Negar Barazandeh. Microbiology Titles Basic Bacteriology, Parasitology, Mycology. 2008.
- Subhash Chandra Parija.Textbook of Microbiology and Immunology. A division of Reed Elsevier India Private Limited. 1st edition.2009.
- Jawetz, Melnick, & Adelberg's. Medical Microbiology. Twenty-Sixth Edition. The McGraw-Hill Companies, Inc. 2010.

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Session: 2024-25	
Part A – Introduction	
Name of Programme	**M.Sc. Microbiology**
Semester	**2**
Name of the Course	**Biostatistics and computer for biologists**
Course Code	**M24-MIC-204**
Course Type	**CC-8**
Level of the course	**400-499**
Pre-requisite for the course (if any)	**NA**
Course Learning Outcomes (CLO)	CO1. The students will know the basics of computer, its functioning and various devices attached to computer. CO2. The student will be familiar with MS office basics as well as basics of operating system and networking CO3. The student will be well versed with different statistical methods: Principles of statistical analysis of biological data. Measures of central tendency, dispersion, skewness and kurtosis. CO4. Student will understand Large Sample Test based on Normal Distribution, Confidence Interval; Application of Chisquare test; Small sample test based on t-test and F test.

Credits	Theory	Practical	Total
	4	0	4
Teaching Hours per week	4	0	4
Internal Assessment Marks	30	0	30
End Term Exam Marks	70	0	70
Max. Marks	100	0	100
Examination Time	3 hours		

Part B- Contents of the Course

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	**Introduction to computer:** Classification of computers –computer generation-low, medium and high level languages. Block Diagram of a computer; Description of each block in detail; concept of input-output devices; compilers and interpreters, mini, main frame and super computer, their characteristics and applications. BIT, BYTE. **Concept of Memory:** Types of Memory; Concept of Central processing Unit (CPU), Control Unit (CU), and Arithmetic Logic Unit (ALU). **Data representation and storage** –binary codes, binary systems and its relationship to Boolean Operations. Different numbers systems and conversions. Secondary storage media.	15
II	**Word Basics :** – Formatting Text and Documents : Auto format, Line spacing, Margins, Borders and Shading, etc. **Microsoft excel:** Data entry, graphs, aggregate functions- formulations and functions (students are expected to be familiar with all operations). **Operating system basics :** Overview, The purpose of operating systems, Types of operating systems, Providing a user interface, Running programs, Managing hardware, Enhancing an OS utility software. **Networking Basics :** Overview, Sharing data anywhere, anytime, The uses of a network, Common types of networks, Hybrid networks, How networks are structured, Network topologies and protocols, Network media, Network hardware. Internet: How internet works? Significance.	15

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1204

III	**Biostatistics:** Statistics, its meaning and objectives .Population samples, frequency tables and their graphs, measures of central tendency (mean, mode, median) and their dispersion. Concepts of moments, Skewness and kurtosis. Intuitive definition of random variables, probability mass function and probability density function, expectation and variance. **Standard distribution**; binomial, Poisson and normal distribution with their important properties and significance.	15
IV	**Fitting of main distributions and testing of goodness** –of – the –fit with special reference to $\chi 2$- test, t –test, Z-test. Fitting of trends; linear and quadratic with least square method. Lines of regression, coefficient of correlation, coefficient of variation and their significance. **Analysis of variance**; one way and two way classification. Brief exposure of three basic principles of design of experiments, treatment, plot and block.	15
	Total Contact Hours	60

Suggested Evaluation Methods

Internal Assessment: 30		**End Term Examination: 70**	
➢ **Theory**	**30**	➢ **Theory:**	**70**
• Class Participation:	5	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Rosne B. Fundamentals of Biostatistics, Cengage Learning.
2. Zar JH. Biostatistical Analysis, Pearson Education 5th ed.
3. Campbell RC .Statistics for Biologists, Cambridge university press.
4. Daniel WW. Biostatistics: A Foundation for Analysis in Health Science, 6th ed., John Wiley
5. Snedecar GW & Cochram WG. Statistical Methods, Oxford Press.
6. White Ron .How Computers Work? Techmedia.

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1/205

Session: 2024-25				
Part A – Introduction				
Name of the Programme	**M.Sc. Microbiology**			
Semester	**2**			
Name of the Course	**Practical based on Papers M24-MIC-201 & M24-MIC-202**			
Course Code	**M24-MIC-205**			
Course Type	**PC-3**			
Level of the course	**400-499**			
Pre-requisite for the course (if any)	**NA**			
Course Learning Outcomes (CLO)	CLO1. The student will be able to isolate the genomic and plasmid DNA from bacterial culture. CLO2. The student will be able to check purity of DNA, through agarose gel electrophoresis and PCR. CLO3. The student will be able to perform transformation study of bacterial cultures CLO4. will learn protocol about isolation of chromosomal and plasmid DNA			
Credits		Theory	Practical	Total
Teaching Hours per week		0	4	4
Internal Assessment Marks		0	8	8
End Term Exam Marks		0	30	30
Max. Marks		0	70	70
Examination Time		0	100	100
			4 hours	
Part B- Contents of the Course				
	Practicals			**Contact Hours**
Course Contents	1. Isolation of plasmid DNA by using alkaline lysis 2. Transformation of plasmid DNA by using CaCl2. 3. Preparation of genomic DNA from bacteria. 4. Demonstration of agarose gel electrophoresis. 5. Demonstration of polymerase chain reaction. 6. Calorimetric estimation of DNA & RNA. 7. To isolate plasmid DNA from a given culture. 8. To prepare agrose gel and to run the plasmid DNA samples 9. Isolation of chromosomal DNA 10. To test the given sample for purity of DNA content. 11. Preparation of competent cell by CaCl2 treatment for transformation			120
Suggested Evaluation Methods				
Internal Assessment: 30			**End Term Examination: 70**	
➢ **Practicum**	**30**		➢ **Practicum**	**70**
• Class Participation:	5		Lab record, Viva-Voce, write-up and execution of the practical	
• Seminar/Demonstration/Viva-voce/Lab records etc.:	10			
• Mid-Term Exam:	15			
Part C-Learning Resources				

Recommended Books/e-resources/LMS:

1. Cappucino JG and Welsh CT. Microbiology: A laboratory manual. 11th edition. Pearson.
2. Thompson DA. Biochemistry Lab Manual. 3rd edition.
3. Segel IH. Biochemical calculations: how to solve mathematical problems in general biochemistry, Wiley, 2nd Edition.
4. Sambrook J & Russell D. Molecular Cloning: A laboratory manual. 4th edition. Cold Spring Harbor laboratory Press.
5. Collee JG, Fraser AG, Marmion BP & Simmons A (eds.). Mackie & McCartney Practical Medical Microbiology. Churchill Livingstone, Edinburgh.
6. Atlas RM, Parks LC & Brown AL. Laboratory Manual of Experimental Microbiology. MosbyYear Book, Inc., Missouri.

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1206

Session: 2024-25			
Part A – Introduction			
Name of the Programme	**M.Sc. Microbiology**		
Semester	**2**		
Name of the Course	**Practical based on Papers M24-MIC-203 & M24-MIC-204**		
Course Code	**M24-MIC-206**		
Course Type	**PC-4**		
Level of the course	**400-499**		
Pre-requisite for the course (if any)	**NA**		
Course Learning Outcomes (CLO)	CLO1. The student will be able to perform sterility testing of a sample and is acquainted with the resident microflora of skin and oral cavity. CLO2. The student will be able to identify human pathogenic microorganisms on selective/ differential media following biosafety norms. CLO3. The student will be able to learn measures of central tendency, dispersion, skewness and kurtosis. CLO4. Student will learn about discrete and continuous random variable, correlation and regression. Emphasis with examples on how descriptive statistics helps in analysing biological sciences data.		
Credits	Theory	Practical	Total
	0	4	4
Teaching Hours per week	0	8	8
Internal Assessment Marks	0	30	30
End Term Exam Marks	0	70	70
Max. Marks	0	100	100
Examination Time	0	4 hours	
Part B- Contents of the Course			
	Practicals		**Contact Hours**
Course Contents	1. To study cultural characteristics of pathogenic bacteria on following selective/differential media: TCBS agar; Hektoen Enteric agar; XLD agar; Endo agar; Salmonella-Shigella agar; Deoxycholate citrate agar 2. To study pathogenicity of *Staphylococcus aureus* by coagulase test 3. To demonstrate the liberation of ammonia from nitrogenous organic compound (ammonification). 4. To perform sterility testing of a sample. 5. To study resident microflora of skin. 6. To study resident microflora of oral cavity 7. Handling of data using measures of central tendency. 8. Handling of data using measures of dispersion. 9. Problems based on skewness and kurtosis. 10. Finding Karl Pearson's correlation coefficient and interpretation of result. 11 Application of Chi-Square Distribution and interpretation of result on given data set a. Chi-square test of proportions. b. Chi-square tests of association. c. Chi-square test of goodness-of-fit		120

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Suggested Evaluation Methods			
Internal Assessment: 30		**End Term Examination: 70**	
➢ **Practicum**	**30**	➢ **Practicum**	**70**
• Class Participation:	5	Lab record, Viva-Voce, write-up and execution of the practical	
• Seminar/Demonstration/Viva-voce/Lab records etc.:	10		
• Mid-Term Exam:	15		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

1. Collee JG, Fraser AG, Marmion BP & Simmons A (eds.). Mackie & McCartney Practical Medical Microbiology. Churchill Livingstone, Edinburgh.
2. Atlas RM, Parks LC & Brown AL. Laboratory Manual of Experimental Microbiology. MosbyYear Book, Inc., Missouri.
3. Danniel WW. Biostatistics: A Foundation for Analysis in the Health Sciences by. John Wiley,
4. Goon AM, Gupta MK and Dasgupta B. Fundamentals of Statistics Vol. I & II. 8th edition. The World Press, India.

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Session: 2024-25			
Part A – Introduction			
Name of the Programme	**M.Sc. Microbiology**		
Semester	**2**		
Name of the Course	**Constitutional, Human and Moral values, and IPR**		
Course Code	**M24-CHM-201**		
Course Type	**CHM**		
Level of the course (As per Annexure-I	**400-499**		
Pre-requisite for the course (if any)	NA		
Course Learning Outcomes (CLO) After completing this course, the learner will be able to:	CLO-1: Learn the different Constitutional Values, Fundamental rights and duties enshrined in the India Constitution. CLO-2: Understand humanism, human virtues and values, and idea of International peace. CLO-3: Grasp the basic concepts of Moral Values and Professional Conduct which are required to become a part of the civil society and for developing professionalism. CLO-4: Understand *concepts of* Intellectual Property Rights, *Copyright, Patent, Trademark etc., and about threats of* Plagiarism.		
Credits	Theory	Practical	Total
	2	0	2
Teaching Hours per week	2	0	2
Internal Assessment Marks	15	0	15
End Term Exam Marks	35	0	35
Max. Marks	50	0	50
Examination Time	3 hours		

Part B- Contents of the Course (Will be available from common pool)

Instructions for Paper- Setter: The examiner will set 9 questions asking two questions from each unit and one compulsory question by taking course learning outcomes (CLOs) into consideration. The compulsory question (Question No. 1) will consist at least 4 parts covering entire syllabus. The examinee will be required to attempt 5 questions, selecting one question from each unit and the compulsory question. All questions will carry equal marks.

Unit	Topics	Contact Hours
I	**Constitutional Values:** Historical Perspective of Indian Constitution; Basic Values enshrined in the Preamble of the Indian Constitution; Concept of Constitutional Morality; Patriotic Values and Ingredients Nation Building; Fundamental Rights and Duties ; Directive Principles of the State Policy.	8
II	**Humanistic Values:** Humanism, Human Virtues and Civic Sense; Social Responsibilities of Human Beings; Ethical ways to deal with human aspirations; Harmony with society and nature; Idea of International Peace and Brotherhood (Vasudhaiv Kutumbkam).	7
III	**Moral Values and Professional Conduct** Understanding Morality and Moral Values; Moral Education and Character Building; Ethics of Relations: Personal, Social and Professional; Introduction to Gender Sensitization; Affirmative approach towards Weaker Sections (SCs, STs, OBCs, EWS & DAs); Ethical Conduct in Higher Education Institutions; Professional Ethics.	8
IV	**Intellectual Property Rights:** Meaning, Origins and Nature of Intellectual Property Rights (IPRs);Different Kinds of IPRs – Copyright, Patent, Trademark, Trade Secret/Dress, Design, Traditional Knowledge; Infringement and Offences of IPRs – Remedies and Penalties; Basics of Plagiarism policy of UGC.	7
	Total Contact Hours	30

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Suggested Evaluation Methods			
Internal Assessment: 15		**End Term Examination: 35**	
➢ **Theory**	**15**	➢ **Theory**	**35**
• Class Participation:	4	Written Examination	
• Seminar/presentation/assignment/quiz/class test etc.:	4		
• Mid-Term Exam:	7		

Part C-Learning Resources

Recommended Books/e-resources/LMS:

- Ahuja, V K. (2017). *Law relating to Intellectual Property Rights*, India, IN: Lexis Nexis.
- Bajpai, B. L., *Indian Ethos and Modern Management*, New Royal Book Co., Lucknow, 2004.
- Basu, D.D., *Introduction to the Constitution of India* (Students Edition) Prentice Hall of India Pvt. Ltd., New Delhi, 20th ed., 2008.
- Dhar, P.L. & R.R. Gaur, *Science and Humanism*, Commonwealth Publishers, New Delhi, 1990.
- George, Sussan, *How the Other Half Dies*, Penguin Press, 1976.
- Govindarajan, M., S. Natarajan, V.S. Sendilkumar (eds.), *Engineering Ethics (Including Human Values)*, Prentice Hall of India Private Ltd, New Delhi, 2004.
- Harries, Charles E., Michael S. Pritchard & Michael J. Robins, *Engineering Ethics*, Thompson Asia, New Delhi, 2003.
- Illich, Ivan, *Energy & Equity*, Trinity Press, Worcester, 1974.
- Meadows, Donella H., Dennis L. Meadows, Jorgen Randers & William W. Behrens, *Limits to Growth: Club of Rome's Report*, Universe Books, 1972.
- Myneni, S.R, Law of Intellectual Property, Asian Law House.
- Narayanan, P, *IPRs*.
- Neeraj, P., &Khusdeep, D. (2014). *Intellectual Property Rights*, India, IN: PHI learning Private Limited.
- Nithyananda, K V. (2019). *Intellectual Property Rights: Protectionand Management*. India, IN: Cengage Learning India PrivateLimited.
- Palekar, Subhas, *How to practice Natural Farming*, Pracheen (Vaidik) KrishiTantraShodh, Amravati, 2000.
- Phaneesh, K.R., *Constitution of India and Professional Ethics*, New Delhi.
- Pylee, M.V., *An Introduction to Constitution of India*, Vikas Publishing, New Delhi, 2002.
- Raman, B.S., *Constitution of India,* New Delhi, 2002.
- Reddy, B., Intellectual Property Rights and the Law, Gogia Law Agency.
- Reddy, N.H., SantoshAjmera, *Ethics, Integrity and Aptitude*, McGraw Hill, New Delhi.
- Sharma, Brij Kishore, *Introduction to the Constitution of India,* New Delhi,
- Schumacher, E.F., *Small is Beautiful: A Study of Economics as if People Mattered*, Blond & Briggs, Britain, 1973.
- Singles, Shubham et. al., *Constitution of India and Professional Ethics,* Cengage Learning India Pvt. Ltd., Latest Edition, New Delhi, 2018.
- Tripathy, A.N., *Human Values*, New Age International Publishers, New Delhi, 2003.
- Wadehra, B.L., Law relating to Intellectual Property, Universal Law Publishing Co.

Relevant Websites, Movies and Documentaries:

- *Value Education Websites*, http://uhv.ac.in, http://www.uptu.ac.in.
- *Story of Stuff*, http://www.storyofstuff.com
- Cell for IPR Promotion and Management: http://cipam.gov.in/.
- World Intellectual Property Organization: https://www.wipo.int/about-ip/en/
- Office of the Controller General of Patents, Designs & Trademarks: http://www.ipindia.nic.in/

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