ANNA UNIVERSITY, CHENNAI
UNIVERSITY DEPARTMENTS
M.TECH. CLIMATE CHANGE AND DISASTER MANAGEMENT (FULL-TIME)
REGULATIONS – 2023
CHOICE BASED CREDIT SYSTEM
I TO IV SEMESTERS CURRICULA AND I SEMESTER SYLLABI

Semester I

S.No.	Course Code	Course Title	Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
Theory								
1	MA3102	Applied Mathematics for Climate and Disaster Solutions	FC	4	0	0	4	4
2	CM3101	Fundamentals of Climate Science toward SDG	PCC	3	0	0	3	3
3	CM3102	Introduction to Disasters and Disaster Management	PCC	3	0	0	3	3
4	CM3103	Climate Modeling and Simulation with AI and Machine Learning	PCC	3	0	4	7	5
5	CM3104	Governance & Policies of Climate Change & Disaster Management	PCC	3	0	0	3	3
6	RM3151	Research Methodology and IPR	RMC	2	1	0	3	3
			Total Credits	**18**	**1**	**4**	**23**	**21**

Semester II

S.No.	Course Code	Course title	Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
Theory								
1		Sectoral Impacts of Climate Change	PCC	3	0	4	7	5
2		Strategies for Climate Change Adaptation & Mitigation - AI/ML solutions	PCC	3	0	0	3	3
3		Geospatial Technologies for Climate Studies	PCC	3	0	4	7	5
4		Infrastructure Resilience and Disaster Management	PCC	3	0	0	3	3
5		Professional Elective- I	PEC	3	0	0	3	3
6		Professional Elective- II	PEC	3	0	0	3	3
7		Seminar	EEC	0	0	2	2	1
			Total Credits	**18**	**0**	**10**	**28**	**23**

Semester III

S.No.	Course Code	Course Title	Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
Theory								
1		Carbon Credits and Climate Finance	PCC	3	0	0	3	3
2		Participatory Approaches in Climate Science & Disaster Risk Management	PCC	3	0	0	3	3
3		Professional Elective- III	PEC	3	0	0	3	3
Practical								
4		Project Phase I	EEC	0	0	12	12	6
			Total Credits	**9**	**0**	**12**	**21**	**15**

Semester IV

S.No.	Course Code	Course Title	Category	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
Practical								
1		Project Phase II	EEC	0	0	24	24	12
			Total Credits	**0**	**0**	**24**	**24**	**12**

Total Credits for the programme = 71

Foundation Courses (FC)

S. No	Course code	Course Name	Periods Per Week			Credits	Semester
			L	T	P		
1.		Applied Mathematics for Climate and Disaster Solutions	4	0	0	4	I
					Total Credits	**4**	

Professional Core Courses (PCC)

S. No	Course code	Course Name	Periods Per Week			Credits	Semester
			L	T	P		
1.		Fundamentals of Climate Science toward SDG	3	0	0	3	I
2.		Introduction to Disasters and Disaster Management	3	0	0	3	I
3.		Climate Modeling and Simulation with AI and Machine Learning	3	0	4	5	I
4.		Governance & Policies of Climate Change & Disaster Management	3	0	0	3	I
5.		Sectoral Impacts of Climate Change	3	0	4	5	II
6.		Strategies for Climate Change Adaptation & Mitigation - AI/ML solutions	3	0	0	3	II
7.		Geospatial Technologies for Climate Studies	3	0	4	5	II
8.		Infrastructure Resilience and Disaster Management	3	0	0	3	II
10.		Carbon Credits and Climate Finance	3	0	0	3	III
11.		Participatory approaches in Climate Science & Disaster Risk Management	3	0	0	3	III
					Total Credits	**37**	

Professional Elective Courses [PEC]

S.No.	Course code	Course Name	Periods Per Week			Credits
			L	T	P	
1.		Community-based Impact and Vulnerability Assessment	3	0	0	3
2.		Urban Resilience to Climate Extremes	3	0	0	3
3.		Climate Change and Public Health: Risks, Resilience, and Adaptation Strategies	3	0	0	3
4.		Sustainable Energy Transitions: Technologies, Policies, and Pathways to Net Zero	3	0	0	3
5.		Climate Change and Forestry and Biodiversity	3	0	0	3
6.		Climate Change and Circular Economy	3	0	0	3
7.		Climate Change and Sustainable Agriculture for Food Security	3	0	0	3
8.		Climate Change and Coastal Ecosystems	3	0	0	3
9.		Greenhouse Gases and Emissions and Inventories	3	0	0	3
10.		Mainstreaming Climate Action: Policy Frameworks, Integration & Implementation	3	0	0	3
11.		Carbon Capture, Utilisation, And Storage (CCUS) in Industries	3	0	0	3
12.		Climate Chemistry	3	0	0	3
13.		Microbes and Climate Change	3	0	0	3
14.		Advanced Remediation for Climate-Induced Pollution	3	0	0	3
15.		Atmospheric Chemistry in Climate Change	3	0	0	3
16.		Introduction to Programming Languages	3	0	0	3
17.		High Performance Computing for Earth System Modeling	3	0	0	3
18.		Climate and Big Data Analytics	3	0	0	3
19.		Urban Disaster Risk and Resilience Planning	3	0	0	3
20.		Disaster Communication, Education, And Community Engagement	3	0	0	3
21.		Climate Change and Water Resources Dynamics	3	0	0	3

Research Methodology and IPR Courses (RMC)

S. No	Course code	Course name	Periods per week			Credits	Semester
			L	T	P		
1.		Research Methodology and IPR	2	1	0	3	I
		Total Credits				3	

Employability Enhancement Courses (EEC)

S. No	Course code	Course name	Periods per week			Credits	Semester
			L	T	P		
1.		Seminar	0	0	2	1	II
2.		Project Work I	0	0	12	6	III
3.		Project Work II	0	0	24	12	IV
		Total Credits				**19**	

Name of the Programme: M.E Climate Change and Disaster Management						
S. No	**Subject Area**	**Credits per Semester**				**Credits Total**
		I	**II**	**III**	**IV**	
1.	**FC**	4	--			**4**
2.	**PCC**	14	12			**37**
3.	**PEC**	---	6	3		**9**
4.	**RMC**	3				**3**
5.	**EEC**	---	1	6	12	**19**
	Total					**71**

MA3102 APPLIED MATHEMATICS FOR CLIMATE AND DISASTER SOLUTIONS **LT P C**
4 0 0 4

UNIT I: OPTIMIZATION FOR RESOURCE ALLOCATION **12**

Formulation of optimization problems – Graphical solutions – Simplex method – Two-phase method – Transportation and assignment models – Applications to climate and disaster management (e.g., resource allocation for disaster relief, water management optimization) – Introduction to linear programming in ML (e.g., support vector machines).

UNIT II: SIMULATION AND RISK MODELING **12**

Discrete event simulation – Monte Carlo simulation – Stochastic simulation – Applications to climate and disaster scenarios (e.g., flood evacuation planning, drought risk assessment) – Agent-based modeling for disaster response – Use of simulation in ML model validation (e.g., cross-validation techniques).

UNIT III: STATISTICAL ESTIMATION AND FORECASTING **12**

Properties of estimators: unbiasedness, consistency, efficiency, sufficiency – Maximum Likelihood Estimation (MLE) – Method of Moments – Time-series analysis for climate data (e.g., ARIMA models for rainfall forecasting) – Bayesian inference for disaster probability estimation – Applications in climate trend analysis.

UNIT IV: STATISTICAL INFERENCE AND HYPOTHESIS TESTING **12**

Sampling distributions – Parameter estimation – Hypothesis testing: tests based on Normal, t, Chi-square, and F distributions for mean, variance, and proportion – Tests for independence and goodness of fit – Non-parametric tests for climate data (e.g., Mann-Kendall test for trend detection) – Statistical validation of ML models (e.g., significance testing for feature importance).

UNIT V: MACHINE LEARNING AND MULTIVARIATE ANALYSIS **12**

Random vectors, mean vectors, and covariance matrices – Multivariate Normal distribution – Principal Component Analysis (PCA) for dimensionality reduction in climate datasets – Introduction to ML algorithms: regression (linear, logistic), decision trees, and random forests – Applications in climate and disaster prediction (e.g., flood risk mapping, crop yield forecasting) – Model evaluation metrics (e.g., RMSE, AUC).from standardized variables.

TOTAL: 60 PERIODS

COURSE OUTCOMES

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

CO1: Formulate and solve real-life optimization problems (e.g., disaster relief allocation) involving resource constraints.
CO2: Simulate climate and disaster scenarios using appropriate tools.
CO3: Estimate parameters using Method of Moments and Maximum Likelihood.
CO4: Apply hypothesis testing for validating climate and disaster models.
CO5: Analyze complex datasets using principal component analysis.

REFERENCES

1. Devore, J.L., Probability and Statistics for Engineering and the Sciences, Cengage Learning, 10th Edition, Boston, 2020.
2. Johnson, R.A., Miller, I., & Freund, J., Miller and Freund's Probability and Statistics for Engineers, Pearson Education, 10th Edition, New York, 2022.

3. Johnson, R.A., & Wichern, D.W., Applied Multivariate Statistical Analysis, Pearson Education, 7th Edition, New Delhi, 2023.
4. Ross, S.M., Probability Models for Computer Science, Academic Press, San Diego, 2020.
5. Taha, H.A., Operations Research: An Introduction, Pearson, 11th Edition, New Delhi, 2022.
6. Winston, W.L., Operations Research: Applications and Algorithms, Cengage Learning, 5th Edition, Boston, 2021.

CO-PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	3	3	2	2
CO2	3	3	3	3	2	2
CO3	3	3	3	3	2	2
CO4	3	3	3	3	2	2
CO5	3	3	3	3	2	2
Avg	3	3	3	3	2	2

CM3101	FUNDAMENTALS OF CLIMATE SCIENCE TOWARD SDG	L T P C
		3 0 0 3

UNIT I: INTRODUCTION TO CLIMATE SCIENCE **9**

Definition and evolution of climate science – Components of the climate system – Differences between weather and climate – Elements of weather and climate – Climate normals and anomalies – Case studies of long-term climate variation – Milankovitch cycles and geological-scale changes – Role of solar radiation and Earth's energy balance. Natural drivers of climate change: tectonic plate movements, volcanic eruptions, solar variability, and ocean circulation changes

UNIT II: ATMOSPHERIC COMPOSITION AND DYNAMICS **9**

Structure and constituents of the atmosphere– Vertical stratification and temperature profiles – Radiation balance and greenhouse gases – Insolation and energy flux – Greenhouse gas lifetimes and Global Warming Potential (GWP) – Atmospheric pressure and wind systems – Pressure gradient force – Sea-land breeze dynamics – Cyclones and anticyclones – General circulation patterns (Hadley, Ferrel, Polar cells) – Ocean-atmosphere coupling phenomena (ENSO, IOD, MJO) – Climate system Tipping points - Influence of pressure systems on climate extremes.

UNIT III: CLIMATE VARIABILITY AND CHANGE **9**

Natural vs anthropogenic climate forcings – Detection and attribution of observed climate change - Paleoclimate proxies (ice cores, tree rings, sediments) – Observed trends in global and regional temperature and precipitation – Decadal and annual anomalies (NASA, NOAA datasets etc.,) – Regional hotspots of climate change – Seasonal rainfall pattern shifts (e.g., Indian monsoon variability) – Global biogeochemical cycles (carbon, methane, nitrogen) – Climate feedbacks (albedo, water vapor, permafrost thawing) – Climate sensitivity analysis.

UNIT IV: TOOLS AND TECHNIQUES IN CLIMATE SCIENCE **9**

Climate observation networks (in-situ and satellite systems) – Climate modeling approaches: RCMs, GCMs, ESMs – Emission scenarios: RCPs and SSPs – Uncertainty in model outputs – Parameterization and boundary/initial conditions – Ensemble modeling: single-model and multi-model (MMEs) – Climate data repositories: CMIP, ERA5, IMD datasets – Techniques for interpretation and visualization of climate data.

UNIT V: CLIMATE SCIENCE AND SOCIETY **9**

Societal impacts of climate science, referencing Climate Change and Public Health, Water Resource Dynamics for sectoral impacts - Strategies for risk communication - Role of indigenous knowledge and community-based resilience- Climate science-policy interface – Nexus between climate science and the Sustainable Development Goals – Sustainability frameworks in climate governance: environmental, social, and economic dimensions – Economic analysis of climate action: cost–benefit frameworks, carbon pricing mechanisms, and climate finance.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of this course, students will be able to:

CO1	Understand the structure, components, and long-term dynamics of the Earth's climate system
CO2	Analyze atmospheric processes, radiation balance, and climate interactions across spatial Scales
CO3	Evaluate the variability and changes in climate using paleoclimatic evidence and modern observational datasets

CO4	Interpret climate model outputs and observational datasets to understand theoretical foundations of climate projections.
CO5	Assess the interface between climate science and society, including policy relevance and adaptation strategies

REFERENCES

1. IPCC. Climate Change 2023: The Physical Science Basis. Cambridge University Press, 2023.
2. Ruddiman, W.F. Earth's Climate: Past and Future. W.H. Freeman & Co., 2013.
3. Peixoto, J.P. & Oort, A.H. Physics of Climate. Springer, 2020.
4. Trenberth, K.E. (Ed.). Climate System Modeling. Cambridge University Press, 1992.
5. Wallace, J.M. & Hobbs, P.V. Atmospheric Science: An Introductory Survey, 2nd Ed., Elsevier, 2006.
6. Hartmann, D.L. Global Physical Climatology, 2nd Ed., Elsevier, 2022.
7. Dessler, A.E. Introduction to Modern Climate Change, 3rd Ed., Cambridge University Press, 2021.

CO – PO MAPPING

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2	2	3	2	2	2
CO2	2	2	3	3	2	2
CO3	3	2	3	3	2	3
CO4	3	3	3	2	3	2
CO5	2	3	2	3	3	3
Avg	2	2	3	3	3	2

• 1-low, 2-medium, 3-high

CM3102 INTRODUCTION TO DISASTERS AND DISASTER MANAGEMENT **L T P C**
3 0 0 3

UNIT I: FUNDAMENTALS OF DISASTER SCIENCE AND RISK ANALYSIS 9

Disaster Terminologies: Hazard, Exposure, Vulnerability, Risk, Capacity, Resilience - Disaster Risk Equation and Disaster Management Cycle - Disaster Typologies: Natural (Geophysical-Hydrometeorological-Biological), Anthropogenic (Industrial-Environmental-Technological) Theoretical Models: Pressure and Release (PAR) Model, Crunch Model, Disaster Crunch Model Disaster Management Cycle and Sendai Framework for Disaster Risk Reduction (SFDRR) Risk profiling and hazard zonation in India.

UNIT II: HAZARD ASSESSMENT AND MITIGATION TECHNIQUES 9

Risk assessment methodologies: Qualitative, Quantitative, Multi-Hazard Risk Indexing Structural and non-structural mitigation: Retrofitting, land-use zoning, watershed-based approaches Critical infrastructure resilience: Lifeline systems, health, transport, water and power sectors Indigenous knowledge systems and community-based disaster risk management (CBDRM) - Ecosystem-based Disaster Risk Reduction (Eco-DRR) and Nature-based Solutions (NbS) for risk mitigation and climate adaptation.

UNIT III: TECHNOLOGY AND TOOLS FOR DISASTER MANAGEMENT 9

Geospatial tools: GIS, Remote Sensing, UAVs, and LiDAR for damage mapping and hazard modelling, Early warning systems: IMD, INCOIS, and NDMA platforms and protocols. Risk simulation models: HEC-RAS (Flood), FEMA's HAZUS, ALOHA (Chemical), and FOSS-based DRR tools. ICT and mobile-based applications for disaster information dissemination.

UNIT IV: RESPONSE, RECOVERY AND RESILIENCE BUILDING 9

Disaster preparedness plans: evacuation, shelter management - Post-disaster response frameworks: relief, rehabilitation, and Build Back Better (BBB) strategies – Recovery planning and resilient infrastructure systems – Community-based resilience building – Risk communication and public engagement methods – Integration of indigenous knowledge in recovery processes – Institutional mechanisms for resilience in vulnerable sectors: water, agriculture, health, coasts, ecosystems, and urban environments.

UNIT V: DISASTER RISK GOVERNANCE AND INSTITUTIONAL FRAMEWORKS 9

Disaster Management Act 2005, NDMA/SDMA/SFDRR Guidelines - Institutional architecture: NDMA, NDRF, MHA, IMD, CWC, INCOIS, ISRO. Risk communication: Principles, protocols, media, and misinformation management - Case Studies.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of this course, students will be able to:

- CO1 Explain fundamental disaster risk concepts, typologies, and theoretical models for hazard-risk analysis
- CO2 Evaluate disaster risk governance systems and institutional frameworks from national and global perspectives
- CO3 Apply hazard and risk assessment tools and propose context-specific mitigation strategies using structural, non-structural, and nature-based approaches
- CO4 Use geospatial and simulation technologies for disaster preparedness, response planning, and early warning
- CO5 Analyze response and recovery mechanisms, post-disaster rehabilitation strategies, and principles of resilient reconstruction

REFERENCES

1. George D. Haddow & Jane A. Bullock (2020). Introduction to Emergency Management (6th ed.). Butterworth-Heinemann.
2. Gupta, A.K., Sreeja Nair (2011). Environmental Knowledge for Disaster Risk Management. NIDM, New Delhi.
3. Brian Tomaszewski (2014). GIS for Disaster Management. CRC Press.
4. NDMA Guidelines: Urban Flooding (2010), Earthquake Management (2007), Cyclone Management (2008)
5. Disaster Management Act (2005), Government of India.
6. S. Parasuraman & P.V. Unnikrishnan (2000). India Disasters Report: Towards a Policy Initiative. OUP India.
7. UNDRR (2023). Global Assessment Report on Disaster Risk Reduction.

CO – PO MAPPING

CO	PEO1	PEO2	PEO3	PEO4	PEO5
CO1	3	2	3	3	2
CO2	2	2	3	3	2
CO3	3	2	3	3	2
CO4	3	3	3	3	2
CO5	3	3	3	3	3
Avg	3	2	3	3	2

• 1-low, 2-medium, 3-high

CM3103 CLIMATE MODELLING AND SIMULATION WITH AI AND MACHINE LEARNING LT P C
3 0 4 5

UNIT I: INTRODUCTION TO CLIMATE MODELS 9

Fundamentals of climate system modelling – Evolution of climate models: conceptual to complex models – Types of climate models: zero-dimensional, energy balance, and general circulation models – Model components: atmosphere, ocean, land, and ice interactions – Key equations and physical basis of climate models - Role of parameterization in representing sub-grid scale processes.

UNIT II: ATMOSPHERIC AND OCEANIC CIRCULATION MODELS 9

Atmospheric dynamics and numerical weather prediction models – Ocean circulation and coupling with atmospheric models – Role of clouds, aerosols, and radiation in climate models – Regional vs. global models: strengths and limitations – Simulation of extreme weather events and climate variability.

UNIT III: REGIONAL AND GLOBAL CLIMATE MODELS 9

Structure and development of General Circulation Models (GCMs) – History of Scenario-based modeling (SRES, RCPs and SSPs) -– Inter-comparison of climate models (CMIP, CORDEX) – Downscaling techniques for regional climate models (RCMs) - Model calibration, validation, Bias correction and performance evaluation – Applications of RCMs in climate impact studies.

UNIT IV: CLIMATE MODEL APPLICATIONS IN RISK ASSESSMENT 9

Modeling climate risks for agriculture, water resources, and health – Role of models in disaster risk reduction and policy planning – Integration of climate models with hydrological and ecological models – Socio-economic impacts and adaptation planning – Uncertainty in projections and communication of model outputs.

UNIT V: UNCERTAINTY ANALYSIS AND AI IN CLIMATE MODELS 9

Sources of uncertainty in climate modelling – Ensemble modeling and probabilistic forecasting – Sensitivity analysis and parameter estimation – Improving model reliability through data assimilation techniques – Introduction to AI and Machine Learning techniques in climate models – Applications of AI/ML in pattern recognition, model tuning, and anomaly detection.

TOTAL: 45 PERIODS

LABORATORY EXPERIMENTS

1. Climate Data Acquisition and Pre-processing
2. Time Series and Climate Data
3. Global Climate Model data Analysis
4. Basic Climate Simulation using Energy Balance Model (EBM)
5. Understanding SSPs and Scenario Simulations
6. Regional Downscaling Methods
7. Ocean-Atmosphere Interaction Analysis (ENSO/IOD)
8. Extreme Weather Event Simulation
9. Climate Model Uncertainty and Ensemble Analysis
10. Validation of Climate Model Results with Observatory Data
11. Climate Risk Mapping with GIS
12. AI/ML in Climate Pattern Detection

TOTAL: (45+ 60) =105 PERIODS

COURSE OUTCOMES

Upon completion of this course, students will be able to:

CO1:	Understand the fundamentals and evolution of climate models, including key physical principles.
CO2:	Analyze atmospheric and oceanic processes simulated through different climate model configurations.
CO3:	Evaluate the strengths, limitations, and applications of global and regional climate models in impact studies.
CO4:	Assess climate model-based risk analysis across various sectors and the role in adaptation and policy planning.
CO5:	Interpret uncertainty in climate models and explore the role of AI and machine learning in enhancing climate projections.

REFERENCES

1. IPCC. Climate Change 2023: The Physical Science Basis. Cambridge University Press, 2023.
2. Eyring, V. et al. Advances in CMIP6 climate model evaluation. Nature Reviews Earth & Environment, 2, 486–504 (2021).
3. Schulthess, T.C. et al. Machine learning for weather and climate modelling. Philosophical Transactions of the Royal Society A, 379(2194), 2021.
4. Flato, G. et al. Evaluation of Climate Models. In: IPCC Climate Change 2013: The Physical Science Basis, Cambridge University Press.
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8. Reichstein, M. et al. (2019). *Deep learning and process understanding for data-driven Earth system science*. *Nature*, 566, 195–204.
9. Rolnick, D. et al. (2022). *Tackling Climate Change with Machine Learning*. *ACM Computing Surveys*.

CO – PO MAPPING

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	3	2	2	2
CO2	3	2	3	3	2	2
CO3	3	2	3	3	3	2
CO4	3	3	3	3	3	3
CO5	3	3	3	2	3	3
Avg	3	2	3	3	3	2

• 1-low, 2-medium, 3-high

CM3104 GOVERNANCE & POLICIES OF CLIMATE CHANGE & DISASTER MANAGEMENT **LT P C 3 0 0 3**

UNIT I: INTRODUCTION TO ENVIRONMENTAL GOVERNANCE AND POLICY FRAMEWORKS 9

Concepts of governance, policy, law, and regulation in the context of climate and disaster management - Principles of environmental and climate governance (equity, transparency, accountability, subsidiarity) - Role of state, non-state, and multilateral actors in climate/disaster governance - Historical evolution of international climate and disaster policies - Global environmental governance architecture: UNEP, UNFCCC, UNDRR, IPCC roles and mandates

UNIT II: INTERNATIONAL AGREEMENTS, FRAMEWORKS AND CONVENTIONS 9

United Nations Framework Convention on Climate Change (UNFCCC), Kyoto Protocol, Paris Agreement - Global Goal on Adaptation (GGA) and Loss and Damage Fund - Sendai Framework for Disaster Risk Reduction (SFDRR) - Sustainable Development Goals (SDGs) and their climate-disaster linkages - Convention on Biological Diversity (CBD) and Ramsar Convention (wetlands and disaster resilience) - Climate finance mechanisms: Green Climate Fund, Adaptation Fund, Warsaw International Mechanism- Ireland and EU climate law context

Unit III: NATIONAL AND SUB-NATIONAL POLICY AND INSTITUTIONAL FRAMEWORKS 9

National Action Plan on Climate Change (NAPCC) – Missions and Implementation -State Action Plans on Climate Change (SAPCCs) – Tamil Nadu and other examples - Disaster Management Act 2005 and institutional setup: NDMA, SDMAs, DDMAs, Urban Disaster Management Authorities (UDMAs) - Climate-resilient development guidelines by NITI Aayog, MoEFCC, and MoHUA - Political economy analysis of climate governance - Integration of climate resilience in Smart Cities, AMRUT, Jal Shakti Abhiyan and Urban Resilience frameworks - Role of Panchayati Raj Institutions and Urban Local Bodies (ULBs) - MGNREGA and its role in Climate resilience and ecosystem-based adaptation

UNIT IV: POLICY INSTRUMENTS AND DECISION-MAKING TOOLS 9

Regulatory instruments: emission standards, building codes, land-use zoning - Market-based instruments: carbon pricing, cap and trade, renewable energy certificates - Incentive-based approaches: subsidies, climate-resilient insurance schemes - Strategic Environmental Assessment (SEA) and participatory decision-making, incorporating Mainstreaming Climate Action - Public-private partnerships and climate innovation hubs - Climate budgeting and mainstreaming in developmental policy- Energy & economic modelling (SDG mapping, OSeMOSYS)

UNIT V: GOVERNANCE CHALLENGES, INNOVATIONS AND CASE STUDIES 9

Barriers to climate and disaster governance: institutional, financial, political, and social - Climate justice, intergenerational equity, and governance in vulnerable communities - Horizontal and Vertical Integration of climate policy across sectors and scales - Innovations: decentralized climate funds, anticipatory governance, urban governance reforms from Urban Risk Reduction and Resilience - Case studies in Flood Management – Integrating DRM with spatial planning, Tamil Nadu Climate Change Mission – Policy innovation at state level Country specific – Community-based adaptation and resilience governance - Green Deal – Policy coherence for climate neutrality - Role of academic institutions, civil society, and youth in governance - Crisis governance, climate futures, community adaptation

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion, students will be able to:

CO1: Critically explain global and media-influenced governance frameworks for climate and disaster resilience.

CO2: Evaluate international agreements, finance mechanisms, and legal instruments for climate adaptation.

C03: Analyze national–state policy architecture with a focus on India's multi-tier governance systems.

C04: Design and apply policy tools, economic models, and participatory mechanisms for informed climate planning.

CO5: Identify governance barriers while proposing innovative, equity-centered solutions drawing from global case studies.

REFERENCES

1. Pandey, R. K. (2024). *Disaster management in India: Policies, institutions, practices* (1st ed.). Routledge India. https://www.routledge.com/Disaster-Management-in-India-Policies-Institutions-Practices/K-Pandey/p/book/9781032522975 routledge.com+1routledge.com+1
2. *Burns, C., & Capstick, S. (2022).* Environmental governance in theory and practice: Climate, disasters and justice*. Springer.*
3. *Dublin City University. (2024).* Dissertation module handbook: Climate Change Policy, Media and Society *[Internal].*
4. *Loughborough University. (2023).* Climate Change Politics & Policy MA: Course Handbook*. Loughborough University.*
5. *UNDRR. (2022).* Sendai Framework for Disaster Risk Reduction 2015–2030*. United Nations.*
6. *Najmi, S., & Mukherjee, S. (2023).* AI and participatory governance in climate resilience*. Wiley-Blackwell.on finance*
7. Shaw, R. (Ed.). (2021). *The Routledge handbook of disaster risk reduction, including climate change adaptation*. Routledge. https://www.taylorfrancis.com/books/edit/10.4324/9781315684260/routledge-handbook-disaster-risk-reduction-including-climate-change-adaptation-ilan-kelman-jessica-mercer-jc-gaillard taylorfrancis.com

CO-PO MAPPING

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	2	3	3	2	3
CO2	3	2	3	3	2	3
CO3	3	2	3	3	2	3
CO4	3	3	3	3	3	3
CO5	3	3	3	3	3	3
Avg	3	2	3	3	2	3

• 1-low, 2-medium, 3-high

RM3151 RESEARCH METHODOLOGY AND IPR **LT P C**
2 1 0 3

UNIT I RESEARCH PROBLEM FORMULATION 9

Objectives of research, types of research, research process, approaches to research; conducting literature review- information sources, information retrieval, tools for identifying literature, Indexing and abstracting services, Citation indexes, summarizing the review, critical review, identifying research gap, conceptualizing and hypothesizing the research gap

UNIT II RESEARCH DESIGN AND DATA COLLECTION 9

Statistical design of experiments- types and principles; data types & classification; data collection - methods and tools

UNIT III DATA ANALYSIS, INTERPRETATION AND REPORTING 9

Sampling, sampling error, measures of central tendency and variation,; test of hypothesis- concepts; data presentation- types of tables and illustrations; guidelines for writing the abstract, introduction, methodology, results and discussion, conclusion sections of a manuscript; guidelines for writing thesis, research proposal; References – Styles and methods, Citation and listing system of documents; plagiarism, ethical considerations in research

UNIT IV INTELLECTUAL PROPERTY RIGHTS 9

Concept of IPR, types of IPR – Patent, Designs, Trademarks and Trade secrets, Geo graphical indications, Copy rights, applicability of these IPR; , IPR & biodiversity; IPR development process, role of WIPO and WTO in IPR establishments, common rules of IPR practices, types and features of IPR agreement, functions of UNESCO in IPR maintenance.

UNIT V PATENTS 9

Patents – objectives and benefits of patent, concept, features of patent, inventive steps, specifications, types of patent application; patenting process - patent filling, examination of patent, grant of patent, revocation; equitable assignments; Licenses, licensing of patents; patent agents, registration of patent agents.

TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of the course, the student can

CO1: Describe different types of research; identify, review and define the research problem

CO2: Select suitable design of experiment s; describe types of data and the tools for collection of data

CO3: Explain the process of data analysis; interpret and present the result in suitable form

CO4: Explain about Intellectual property rights, types and procedures

CO5: Execute patent filing and licensing

REFERENCES:

1. Cooper Donald R, Schindler Pamela S and Sharma JK, “Business Research Methods”, Tata McGraw Hill Education, 11e (2012).
2. Soumitro Banerjee, “Research methodology for natural sciences”, IISc Press, Kolkata, 2022,
3. Catherine J. Holland, “Intellectual property: Patents, Trademarks, Copyrights, Trade Secrets”, Entrepreneur Press, 2007.

4. David Hunt, Long Nguyen, Matthew Rodgers, “Patent searching: tools & techniques”, Wiley, 2007.
5. The Institute of Company Secretaries of India, Statutory body under an Act of parliament, “Professional Programme Intellectual Property Rights, Law and practice”, September 2013.