MAR BASELIOS COLLEGE OF ENGINEERING AND TECHNOLOGY

(Autonomous)

Department of Civil Engineering

List of Institute Electives for 2023 curriculum

Institute Elective I						
Slot	**Category**	**Course Code**	**Courses**	**L-T-P-J**	**Hours**	**Credit**
E	IEC	23IEL31A	Green Building and Energy Management	3-0-0-0	3	3
E	IEC	23IEL31B	Engineering Project Management	3-0-0-0	3	3
E	IEC	23IEL31C	Disaster Mitigation and Management	3-0-0-0	3	3
E	IEC	23IEL31D	Environmental Impact Assessment and Life Cycle Analysis	3-0-0-0	3	3

Institute Elective II						
Slot	**Category**	**Course Code**	**Courses**	**L-T-P-J**	**Hours**	**Credit**
E	IEC	23IEL42A	Global Climate Change	3-0-0-0	3	3
E	IEC	23IEL42B	Environmental Health and Safety	3-0-0-0	3	3
E	IEC	23IEL42C	Application of Remote Sensing and GIS	3-0-0-0	3	3
E	IEC	23IEL42D	Circular Economy for Sustainable Development	3-0-0-0	3	3

INSTITUTE ELECTIVE I

Course Code	Course Name	Category	L	T	P	J	Credit	Year of introduction
23IEL31A	GREEN BUILDING AND ENERGY MANAGEMENT	IEC	3	0	0	0	3	2023

i) COURSE OVERVIEW

Goal of this course is to expose the students to the principles and practices of green building design, construction and operation, with a focus on energy management and sustainability.

ii) COURSE OUTCOMES

After the completion of the course, the student will be able to:

CO1	Explain the principles, benefits, and key certifications of green buildings and sustainable design.	Understand	
CO2	Describe sustainable construction materials, waste management, and energy-efficient building systems.	Understand	
CO3	Apply energy management strategies, renewable energy technologies, and smart building techniques.	Apply	
CO4	Discuss building performance assessment methods, energy audits, BIM, and sustainability policies.	Understand	

iii) SYLLABUS

Introduction to Green building - benefits, and history, sustainability and major certifications like LEED, IGBC, and GRIHA.

Eco-friendly materials - water-saving methods, effective waste management in sustainable construction.

Energy-efficient MEP systems - smart technologies, and renewable energy sources like solar, wind, and geothermal.

Passive/active design - water and energy conservation, indoor quality, site planning, and energy audits.

Building performance tools - BIM, LCA - policies, incentives, and real-world green building case studies and trends.

iv) a) TEXTBOOKS

1. Kibert, C. J., Sustainable Construction: Green Building Design and Delivery, 5th edition, Wiley, ISBN: 9781119706455, 2022.
2. Ching, F. D. K., & Shapiro, I. M., Green Building Illustrated, 2nd edition, Wiley, ISBN: 9781119584459, 2020.

3. Capehart, B. L., Turner, W. C., & Kennedy, W. J., Guide to Energy Management, 8th edition, CRC Press, ISBN: 9780367333427, 2020.

b) REFERENCES

1. Yang, P., Renewable Energy: Challenges and Solutions, Springer, ISBN: 9783031421034, 2024.
2. Uherova Hasbani, K., Sustainable Energy Management: Policies and Technologies, Springer, ISBN: 9783030613782, 2021.
3. Kubba, S., Handbook of Green Building Design and Construction: LEED, BREEAM, and Green Globes, 2nd edition, Butterworth-Heinemann, ISBN: 9780128104439, 2016.
4. Sayigh, A., Sustainability, Energy, and Architecture: Case Studies in Realizing Green Buildings, Elsevier, ISBN: 9780123972705, 2016.
5. Lechner, N., Heating, Cooling, Lighting: Sustainable Design Methods for Architects, 4th Ed., Wiley, ISBN: 9781118582425, 2014.
6. Wilson, A., The Building Green Guide to Insulation Products and Practices, Building Green, Inc., ISBN: 9781934429257, 2013.
7. Balcomb, J. D., Passive Solar Buildings, MIT Press, ISBN: 9780262518844, 2013.
8. Yudelson, J., The Green Building Revolution, Island Press, ISBN: 9781597261791, 2008.

v) COURSE PLAN

Module	Contents	No. of hours
I	Introduction to Green Building and Sustainable Design - Definition and principles of green buildings, history and evolution, benefits (environmental, economic, health), key certifications (LEED, BREEAM, WELL, IGBC, GRIHA). Introduction to sustainability concepts - climate-responsive design, green building rating systems - their application in real-world projects.	**9**
II	Sustainable Construction Materials and Waste Management - Low-impact and eco-friendly materials - Recycled and locally sourced materials, Green insulation solutions, Green certifications for materials (Cradle to Cradle, FSC), Rainwater harvesting, greywater recycling, and smart water sensors, Wastewater treatment & solid waste management in green buildings.	**9**
III	Building Systems for Energy Efficiency and Renewable Energy - Overview of mechanical, electrical, and plumbing (MEP) systems in buildings, advanced Heating, Ventilation, and Air Conditioning (HVAC) technologies, energy-efficient lighting and control systems, smart building technologies and automation. Renewable energy systems for buildings - solar photovoltaic (PV) and thermal systems, wind energy integration, geothermal heat pumps, biomass energy systems, energy storage solutions, and smart grid integration.	**9**

IV	Sustainable Design Principles and Energy Management - Energy efficiency principles and strategies - passive and active design techniques, water conservation methods, indoor environmental quality improvement strategies. Site selection and planning considerations for optimizing energy use and sustainability - importance of energy management- energy consumption patterns in buildings - energy audits.	**9**
V	Building Performance Assessment, Policies, and Case Studies - Energy auditing techniques and tools, Building Information Modelling (BIM) for sustainable building design and operation, Life Cycle Assessment (LCA) to measure environmental impact, financial incentives and government regulations for sustainable buildings, case studies of successful green buildings, emerging trends and innovations in green building technology.	**9**
	Total hours	**45**

vi) ASSESSMENT PATTERN

Continuous Assessment: End Semester Examination – 40: 60

Continuous Assessment		
Attendance	:	5 marks
Assignments	:	15 marks
Assessment through Tests	:	20 marks
Total Continuous Assessment	:	**40 marks**
End Semester Examination	:	**60 marks**
TOTAL	:	**100 marks**

vii) CONTINUOUS ASSESSMENT TEST

No. of tests	:	02
Maximum Marks	:	30
Test Duration	:	1 ½ hours
Topics	:	2 ½ modules

viii) END SEMESTER EXAMINATION

Maximum Marks	:	60
Exam Duration	:	3 hours

Course Code	Course Name	Category	L	T	P	J	Credit	Year of introduction
23IEL31B	ENGINEERING PROJECT MANAGEMENT	IEC	3	0	0	0	3	2023

i) COURSE OVERVIEW

This course is designed to equip professionals with the skills and insights necessary to excel in complex project environments. The course introduces students to importance of project management as it affects strategy and business success. It introduces the concept of slack and of crashing and acquaints the complexities of scheduling multi-project programs.

ii) COURSE OUTCOMES

After the completion of the course, the student will be able to:

CO 1	Explain the fundamental concepts of project management, project life cycle, scope, and the role of the project manager.	Understand
CO 2	Develop project networks using various techniques, perform scheduling using forward and backward pass methods to identify critical paths and slack times.	Apply
CO3	Identify the role of Project Management in instructional technology and project development using appraisal techniques, cost estimation, and social cost-benefit analysis.	Apply
CO 4	Apply network flow concepts to project scheduling and optimize resource allocation in complex project scheduling scenarios	Apply

iii) SYLLABUS

Foundations and Environment of Project Management, Project Life Cycle & Selection Methods, Project Proposal & Scope Definition, Work Breakdown Structure (WBS), PMBOK Framework

Project Network Development, Forward and Backward Pass Computations, Critical Path Algorithm, Total & Free Slack, Three Time Estimates (PERT), Mean, Variance of Activity Times, Event-Oriented Critical Path Algorithm, Schedule Date Probability (PERT Analysis)

Generation and Screening of Project Ideas, Project Rating Index, Cost Estimation, Social Cost-Benefit Analysis (UNIDO Method), Economic Pricing, Income Distribution Impact, Merit/Demerit Goods, Little-Mirrlees Approach

Flow Network for Critical Path, Time-Cost Trade Off, Chance-Constrained Linear Programming in PERT

Resource Allocation & Levelling Techniques, Complexity with Limited Resources, Demand Levelling for Key Resources, Heuristic Programs for Resource Allocation, Project Crashing (Time-Cost Optimization)

iv) a) TEXTBOOKS

1. J. R. Meredith and S. J. Mantel, *Project Management: A Managerial Approach*, 8th ed. Hoboken, NJ, USA: John Wiley & Sons Inc., 2012, ISBN: 978-1-118-09473-8.
2. P. I. Parameshwar, *Engineering Project Management with Case Studies*. New Delhi, India: Vikas Publishing, 2005, ISBN: 978-81-259-1874-5.
3. P. Chandra, *Projects: Planning, Implementation and Control,* 8th ed. New Delhi, India: Tata McGraw Hill, 2017, ISBN: 978-93-5260-724-0.

b) REFERENCES

1. Project Management Institute (PMI), *A Guide to the Project Management Body of Knowledge (PMBOK Guide)*, 5th ed. Newtown Square, PA, USA: Project Management Institute, 1996, ISBN: 978-1-93389-051-7.
2. C. F. Gray and E. W. Larson, *Project Management: The Managerial Process*, 8th ed. New York, NY, USA: McGraw-Hill Education, 2020, ISBN: 978-1-260-23886-0.
3. L. S. Srinath, *PERT & CPM: Principles and Applications*. New Delhi, India: East-West Press, 2001, ISBN: 978-81-7678-136-7.

v) COURSE PLAN

Module	Contents	No. of hours
	Foundations of Project Management, Project Life Cycle, Project Environment, Project Selection, Project Proposal, Project Scope, Work Breakdown Structure. Project Management Body of Knowledge (PMBOK), Role of Project manager, SWOT Analysis in Project Management, Project Organisation and Structure	**8**
II	Development of project network, dummy activities, activity on node networks, cyclic network, forward pass and backward pass computations, algorithm for critical path, total slacks, free slacks and their interpretations. Three time estimates for activities, estimation of mean and variance of activity times, event oriented algorithm for critical path, probability of meeting a schedule date.	**10**
III	Analysis and appraisal generation of project ideas, scouting for project ideas, preliminary screening, project rating index, and cost of project. Social cost-benefit analysis, UNIDO approach, the net benefit in terms of economic prices, measurement of impact on distribution, savings impact and its value, income distribution impact, adjustment for merit and demerit, goods little Mirrless approach.	**9**

IV	A flow network interpretation for determination of critical paths, Time-Cost Trade off, Chance constrained linear programming for probabilistic durations of activities in PERT network	**9**
V	Resource allocation and levelling, Complexity of project scheduling with limited resources, levelling the demands on key resources, a simple heuristic program for resource allocation, project crashing	**9**
	Total	**45 hours**

vi) ASSESSMENT PATTERN

Continuous Assessment: End Semester Examination – 40: 60

Continuous Assessment		
Attendance	:	5 marks
Assignments	:	15 marks
Assessment through Tests	:	20 marks
Total Continuous Assessment	:	**40 marks**
End Semester Examination	:	**60 marks**
TOTAL	:	**100 marks**

vii) CONTINUOUS ASSESSMENT TEST

No. of tests	:	02
Maximum Marks	:	30
Test Duration	:	1 ½ hours
Topics	:	2 ½ modules

viii) END SEMESTER EXAMINATION

Maximum Marks	:	60
Exam Duration	:	3 hours

Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23IEL31C	DISASTER MITIGATION AND MANAGEMENT	IEC	3	0	0	0	3	2023

PRE-REQUISITE: Nil

i) COURSE OVERVIEW

The goal of this course is to expose the students to the fundamental concepts of disaster mitigation and management. The course details the various phases of disaster management cycle and the measures to mitigate disaster risks.

ii) COURSE OUTCOMES

After the completion of the course, the student will be able to:

CO 1	Explain the fundamental concepts and terminology related to disaster management.	Understand
CO 2	Explain hazard and vulnerability types and methodologies for disaster risk assessment	Understand
CO 3	Identify the core elements and phases of disaster management cycle and the various measures to mitigate disaster risks	Apply
CO 4	Explain the legislations and best practices for disaster mitigation and management at national and international level	Understand

iii) SYLLABUS

Interaction between various Earth Systems and their role in disasters, climate change and its impact on disasters, Key concepts and Terminology related to disaster management

Types of hazards and vulnerability assessments, Disaster risk assessment

Phases of disaster management cycle, Measures for disaster risk reduction- prevention, mitigation, preparedness, disaster response, relief, Participatory stakeholder engagement, Disaster communication, Capacity building.

Common disaster types in India, Legislations in India on Disaster Management- National Disaster Management Policy- Institutional arrangements for disaster management in India, The Sendai Framework for Disaster risk reduction.

iv) a) TEXTBOOKS

1) Coppola, D.P., Introduction to International Disaster Management, Elsevier Science (B/H), London, 2020. ISBN : 9780128173688.
2) Srivastava, H.N., Gupta, G.D., Management of Natural Disasters in developing countries, Daya Publishers, 2007. ISBN-13: 9789389569438

3) Subramanian, R., Disaster Management, Vikas Publishing House, 2018. ISBN-13: 9789352718702
4) Sulphey, M.M., Disaster Management, PHI Learning, 2016. ISBN-13: 9788120352209

b) REFERENCES

1) NDMA, National Policy on Disaster Management, Ministry of Home Affairs, Government of India,2009.
2) National Disaster Management Division, Disaster Management in India - A Status Report, Ministry of Home Affairs, Government of India, New Delhi,2004.
3) National Disaster Management Plan, NDMA, Ministry of Home Affairs, Government of India, 2019.
4) Disaster Management Training Manual, UNDP, 2016
5) United Nations Office for Disaster Risk Reduction, Sendai Framework for Disaster Risk Reduction 2015-2030, 2015

v) COURSE PLAN

Module	Contents	No. of hours
I	Interaction between various Earth Systems (Lithosphere, Atmosphere, Hydrosphere, Biosphere) and their role in disasters, Climate change and its impact on disasters. Definition and meaning of key terms in Disaster mitigation and management – disaster, hazard, exposure, vulnerability, risk, risk assessment, risk mapping, capacity, resilience, disaster risk reduction, disaster risk management, early warning systems, disaster preparedness, disaster prevention, disaster mitigation, disaster response, damage assessment, crisis counselling, needs assessment	**9**
II	Hazards- types- hazard mapping, Vulnerability types and their assessment- Physical, social, economic and environmental vulnerability. GIS and Remote Sensing applications in disaster risk mapping. Core elements of disaster risk assessment, Process of risk assessment, Methodologies for risk assessment.	**9**
III	Disaster management phases- prevention, mitigation, preparedness, response, relief. Role of Artificial Intelligence and IOT in Disaster Early Warning Systems. Case studies on successful disaster response models.	**9**
IV	Participatory stakeholder engagement, Disaster communication-methods, barriers, Crisis counselling. Capacity building- Structural measures, non-structural measures Capacity assessment. Disaster simulation exercises and role-playing activities.	**9**

V	Common disaster types in India. Disaster legislations in India- National disaster management policy, Institutional arrangements for disaster management in India. The Sendai Framework for Disaster risk reduction and targets- priorities for action, guiding principles.	**9**
	Total hours	**45**

vi) ASSESSMENT PATTERN

Continuous Assessment: End Semester Examination – 40: 60

Continuous Assessment		
Attendance	:	5 marks
Assignments	:	15 marks
Assessment through Tests	:	20 marks
Total Continuous Assessment	:	**40 marks**
End Semester Examination	:	**60 marks**
TOTAL	:	**100 marks**

vii) CONTINUOUS ASSESSMENT TEST

No. of tests	:	02
Maximum Marks	:	30
Test Duration	:	1 ½ hours
Topics	:	2 ½ modules

viii) END SEMESTER EXAMINATION

Maximum Marks	:	60
Exam Duration	:	3 hours

Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23IEL31D	ENVIRONMENTAL IMPACT ASSESSMENT AND LIFE CYCLE ANALYSIS	IEC	3	0	0	0	3	2023

PRE-REQUISITE: Nil

i) COURSE OVERVIEW

This course introduces students to Environmental Impact Assessment (EIA) and Life Cycle Analysis (LCA) as key tools for assessing environmental impacts from developmental projects, industries and products**.** Students will learn about environmental regulations and EIA methodologies along with LCA principles and applications in environmental management and circular economy. The course will also cover environmental management plans, audits, and case studies on real-world applications**.**

ii) COURSE OUTCOMES

After the completion of the course, the student will be able to:

CO 1	Explain the fundamental concepts and importance of Environmental Impact Assessment (EIA) and Life Cycle Analysis(LCA)	Understand
CO 2	Discuss the various environmental legislations and EIA clearance procedure in India	Understand
CO 3	Apply various EIA and LCA methodologies for impact assessment and decision making	Apply
CO 4	Prepare impact assessment and audit reports and LCA frameworks for real-world applications	Apply

iii) SYLLABUS

Introduction to EIA and Environmental Legislations, Environmental clearance process in India, Types of EIA, EIA methodologies, Life cycle analysis- fundamentals and applications, Environmental Management Plan (EMP), Environment Audit, ISO 14001 standards , EIA & LCA case studies - highway project, hydro-electric power plant, airport project, quarry mining project, solid waste management project.

iv) a) TEXTBOOKS

1) Canter, L. W., Environmental Impact Assessment, McGraw Hill Inc., New York, 1996. ISBN-10: 0071141030
2) Curran, M. A., Life Cycle Assessment Handbook: A Guide for Environmental Sustainability, Wiley, 2012. ISBN-13: 978-1118099728
3) Marriott, B.B., Environmental Impact Assessment: A Practical Guide, McGraw Hill Professional, 1997. ISBN-13: 978-0070404106

b) REFERENCES

1) Glasson, J. and Therivel, R., Introduction to Environmental Impact Assessment, Routledge Publications, Fifth edition, 2019. ISBN-13: 978-1138600751
2) Lawrence, D. P., Environmental Impact Assessment (Practical Solutions to Recurrent Problems), Wiley International, New Jersey, 2003. ISBN-13: 978-0471457220
3) Ministry of Environment and Forests, Govt. of India, EIA Notification, 2006.
4) Guinée, J. B. (Ed.), Handbook on Life Cycle Assessment: Operational Guide to the ISO Standards, Springer, 2002. ISBN-13: 978-1402002281

v) COURSE PLAN

Module	Contents	No. of hours
I	Definition and need for EIA, Evolution of EIA- Global and Indian Scenario, Environmental legislations in India- The Environmental (Protection) Act 1986, Environmental standards for water, air and noise quality, EIA Notification 2006 and draft amendments 2024, Environmental clearance process in India- screening- scoping- public participation-stakeholder involvement- public hearings, Appraisal- Form1- Categorisation of projects- Generic structure of EIA report- Terms of Reference (ToR),Single Window Clearance.	**9**
II	Types of EIA- Strategic-Regional- Sectoral- Project level, Rapid EIA and comprehensive EIA, EIA Methodologies- Ad hoc-Checklist-Matrix-Network-Overlay methods, Impact prediction and assessment (water , air, noise, ecology), Socio-economic and cultural impacts	**10**
III	Introduction to Life Cycle Analysis (LCA) – Definition—Need-importance –applications in environmental management and sustainability, Phases of LCA- Goal & Scope Definition- Life Cycle Inventory (LCI)- Life Cycle Impact Assessment (LCIA)- Interpretation of LCA results, LCA Methodologies-Process-based, Input-Output, Hybrid Approaches, LCA and circular economy-role of LCA in sustainable product design-circular economy principles and lifecycle thinking	**10**
IV	Environmental Management Plan (EMP)- purpose and importance of EMP- Content of an EMP- Environmental monitoring programs, Environment Audit- need, types and benefits-Environmental audit procedures, ISO 14001 standards for Environmental Management- importance, salient features - stages in implementation- benefits- corporate environmental	**8**

	responsibility	
V	Case studies on EIA and LCA applications- Highway Projects- Hydro-Electric Power Plants, Airport Projects, Quarry Mining projects, Solid waste management Projects. Comparison of EIA and LCA approaches in decision making	**8**
	Total hours	**45**

vi) ASSESSMENT PATTERN

Continuous Assessment: End Semester Examination – 40: 60

Continuous Assessment		
Attendance	:	5 marks
Assignments	:	15 marks
Assessment through Tests	:	20 marks
Total Continuous Assessment	:	**40 marks**
End Semester Examination	:	**60 marks**
TOTAL	:	**100 marks**

vii) CONTINUOUS ASSESSMENT TEST

No. of tests	:	02
Maximum Marks	:	30
Test Duration	:	1 ½ hours
Topics	:	2 ½ modules

viii) END SEMESTER EXAMINATION

Maximum Marks	:	60
Exam Duration	:	3 hours

INSTITUTE ELECTIVE II

Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23IEL42A	GLOBAL CLIMATE CHANGE	IEC	3	0	0	0	3	2023

i) COURSE OVERVIEW

The course aims to educate students about the causes and impacts, adaptive measures, and mitigation strategies of climate change. The course also covers the global and regional level policies and sustainable practices to control the factors influencing climate change. Students will gain knowledge in diverse domains of climate change.

ii) COURSE OUTCOMES

After the completion of the course, the student will be able to:

CO1	Explain the changes and mechanisms that have occurred in the climate of earth over the years	Understand
CO2	Explain the impacts of climate change on various environmental components, locally and globally	Understand
CO3	Explain the global initiatives to address climate change challenges and mitigation measures adopted	Understand
CO4	Identify mitigation and adaptation strategies to address climate change	Apply
CO5	Make use of carbon sequestration methods and carbon conversion technologies to reduce carbon emissions	Apply

iii) SYLLABUS

Atmospheric structure and composition- components of terrestrial climate system and their interactions. Drivers of climate change Climate change vulnerability assessment, Economics of climate change, Impacts of climate change. International Initiatives, Goals of Climate Policy, Pricing Carbon, Carbon Pricing Instruments Climate change Mitigation: Renewable energy sources, Ecosystem-based adaptation- nature based solutions- Green technologies for sustainable water management, Non-energy approaches to Climate Change Mitigation: Recovery, sequestration, Carbon Conversion Technologies

iv) a) TEXTBOOKS

1) Christensen, J. H., Hewitson, B., Busuioc, A., Chen, A., Gao, X., Held, & Whetton, P. (Eds.). 2007 Regional climate projections. In Climate change 2007: The physical science basis (pp. 847-940). Cambridge University Press. 2007 ISBN: 978-0521705977.
2) Stern, N. The economics of climate change: The Stern review. Cambridge University Press. 2007. ISBN: 978-0521700804.

b) REFERENCES

1) Intergovernmental Panel on Climate Change (IPCC). Climate change 2022: Mitigation of climate change: Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press.2022. ISBN: 978-1009208463.
2) Ministry of Environment, Forest and Climate Change (MoEFCC), India's long-term low-carbon development strategy. Ministry of Environment, Forest and Climate Change, Government of India.2022.
3) Yamaguchi, M. Climate change mitigation: Balanced approach to climate change. Springer London Heidelberg New York. 2012. ISBN: 978-3642324686
4) Chen, W.-Y., Suzuki, T., & Lackner, M. Handbook of climate change mitigation and adaptation. 2nd edition. Springer. 2017. ISBN: 978-3319456049
5) Markandya, A. Climate change and sustainable development: Prospects for developing countries 1 st edition Routledge. 2002. ISBN: 978-0415235203
6) Maslin, M Climate change: A very short introduction (3 rd edition.). Oxford University Press.2014. ISBN: 978-0198702914

v) COURSE PLAN

Module	Contents	No. of hours
I	**Introduction to climate change**: Atmospheric structure and composition- components of terrestrial climate system and their interactions. Drivers of climate change- Solar radiation and global energy budget.	9
II	**Climate change vulnerability assessment**, Economics of climate change, Impacts of climate change: Impact on oceans-coastal regions- polar regions, Impact on agriculture-livestock-biodiversity- human health, Case studies on climate change impacts.	9
III	**Carbon Emissions reducing strategies:** The Kaya Identity: Energy Use, Efficiency, and Conservation, Reducing Carbon Emissions: Bottom-Up Approaches, Top-Down Approaches, The Cost of Reducing Emissions, International Initiatives, Goals of Climate Policy, Climate Justice, Pricing Carbon, Carbon Pricing Instruments	9
IV	**Climate change Mitigation:** Long term and short-term mitigation options. Energy Conservation and Fuel Efficiency, Renewable energy sources, Nuclear Energy, Geoengineering. Ecosystem-based adaptation- nature based solutions Green technologies for sustainable water management, Case studies	9

V	**Climate Policies and Carbon Conversion Technologies:** Non-energy approaches to Climate Change Mitigation: Recovery sequestration various carbon sequestration methods disposal of greenhouse gases. Carbon Conversion Technologies: Chemical, Biological and Catalytic approaches.	**9**
	Total hours	**45**

vi) CONTINUOUS ASSESSMENT PATTERN

Attendance	:	5 marks
Continuous Assessment Test(2Numbers)	:	20 marks
Assignment/Project/Case study etc	:	15 marks
Total	:	**40 marks**

vii) CONTINUOUS ASSESSMENT TEST

No. of test	:	2
Maximum mark	:	30 Marks
Test duration	:	1.5 hours
Topic	:	2.5 Module

viii) END SEMESTER EXAMINATION

Maximum mark	:	**60 Marks**
Exam duration	:	3 hours

Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23IEL42B	ENVIRONMENTAL HEALTH AND SAFETY	IEC	3	0	0	0	3	2023

i) COURSE OVERVIEW

This course provides fundamental knowledge on environmental health and safety, workplace hazards, industrial hygiene, and pollution control measures. It equips students with skills to assess, manage, and mitigate risks in various industrial and environmental settings.

ii) COURSE OUTCOMES

After the completion of the course, the student will be able to:

CO 1	Explain toxicology principles and occupational health hazards in industries	Understand
CO 2	Identify the various chemical, biological and physical hazards impacting human health	Apply
CO 3	Identify safety measures in construction, thermal and other hazardous industries	Apply
CO 4	Explain suitable strategies to mitigate the impact of environmental pollutants on human health and the ecosystem	Understand
CO 5	Apply risk assessment strategies and emergency preparedness plans for industrial safety	Apply

iii) SYLLABUS

Introduction to occupational health, hygiene and toxicology, Hazard identification and control measures, Industrial safety- construction and thermal industry, Environmental health and pollution control, Workplace safety and risk management

iv) a) TEXTBOOKS

1) R.K. Jain and Sunil S. Rao, Industrial Safety, Health and Environment Management Systems, 4th Edition, Khanna Publishers, New Delhi, ISBN 13: 978-8174092106, 2006.
2) Bill Taylor, Effective Environmental, Health and Safety Management Using the Team Approach, 1st Edition, Culinary and Hospitality Industry Publications Services, ISBN 13: 978-0471682318, 2005.
3) Brian J Gallant, The Facility Managers Guide to Environmental Health and Safety, Government Inst. Publ., ISBN 13: 978-0865871878, 2008.
4) Roger L. Brauer, Safety and Health for Engineers, 3rd edition, Wiley, ISBN 10: 1118959450, 2016.

b) CODES OF PRACTICE

1) Occupational Safety, Health and Working Conditions Code, Government of India, 2020.
2) Factories Act, Government of India, 1948.

c) REFERENCES

1) Mackenzie L Davis and David A. Cornwell, Introduction to Environmental Engineering, 6th Edition, McGraw Hill Education (India), ISBN 13: 9781260241099, 2023 .
2) McCornick E J and Sanders M S, Human Factors in Engineering and Design, 5th Edition, Tata McGraw-Hill, ISBN 13: 978-0070549012, 1996.
3) S.Z. Mandrof, Handbook of Occupational Safety and Health, 3rd edition, John Willey and Sons, New York, ISBN: 9781118947265, 2019.
4) Encyclopedia of Occupational Health and Safety, Vol.I & II, 4th edition, International Labour Organisation, Geneva, ISBN 92-2-109203-8, 1998.
5) Barbara A. Plog, Fundamentals of Industrial Hygiene, National Safety Council, 6th edition, ISBN 13: 978-0879123123, 2019.
6) M.H.Fulekar, Industrial Hygiene and Chemical Safety, I K International, ISBN 13: 9788188237920, 2006.

v) COURSE PLAN

Module	Contents	No. of hours
I	Introduction to occupational health , hygiene and toxicology Workplace safety- socio-economic implications, job hazards and ergonomic factors; Factories Act (1948) and OSHA regulations- key provisions, employee rights, employer responsibilities; Occupational diseases- Musculoskeletal disorders, Carcinogens, respiratory hazards (Silicosis, Asbestosis, Pneumoconiosis); Toxic substances- Lead, Nickel, Chromium, Manganese, CO poisoning -exposure limits and toxicological assessment	**10**
II	Chemical hazards- dust, fumes, vapours, gases- control methods and personal protective measures; Biological hazards- bacteria, viruses, fungi, parasitic agents- control strategies- biosafety levels- biohazard disposal; Physical hazards- noise pollution- OSHA noise exposure standards, industrial audiometry tests (SAT, SRT)- Noise and vibration control techniques; Emerging chemical contaminants and nanomaterial hazards in industrial settings	**9**

III	Safety in Construction Industry- scaffolding, welding, excavation, concreting- risk assessment and control measures; Electrical safety- hazards, electrocution risks, safety precautions for heavy power equipment; Thermal industry safety- radiation Hazards, exposure risks, monitoring instruments (TLD badge, area survey meters), radioactive disposal; Process safety management (PSM) in high-risk industries, Contractor safety management system, Work at Height, Confined space entry , Different types of Safety work permit systems	**9**
IV	Air pollution- industrial emissions, health effects, air quality standards; Water pollution- industrial effluents, impact on human health, CPCB water quality standards; Waste management- hazardous waste handling, E-waste management, Battery waste management, Zero Liquid discharge system (ZLD) Recycling and circular economy concepts, Sustainable practices in construction , Case studies on green buildings and environmental impact mitigation	**9**
V	Safe working environments - safety inspections, emergency response planning, accident investigation; First-aid training- CPR, electrical shock response, chemical exposure first-aid; Workplace safety and occupational welfare measures- rest rooms, canteens, personal protective equipment (PPE); Risk assessment techniques- HAZOP, FMEA, Emergency preparedness case studies , Safety & Environment Mock drills, Material Safety Data Sheet (MSDS), Near miss incident reporting	**8**
	Total hours	**45**

vi) ASSESSMENT PATTERN

Continuous Assessment: End Semester Examination – 40: 60

Continuous Assessment		
Attendance	:	5 marks
Assignments	:	15 marks
Assessment through Tests	:	20 marks
Total Continuous Assessment	:	**40 marks**

End Semester Examination	:	**60 marks**
TOTAL	:	**100 marks**

vii) CONTINUOUS ASSESSMENT TEST

No. of tests	:	02
Maximum Marks	:	30
Test Duration	:	1 ½ hours
Topics	:	2 ½ modules

viii) END SEMESTER EXAMINATION

Maximum Marks	:	60
Exam Duration	:	3 hours

Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23IEL42C	APPLICATION OF REMOTE SENSING AND GIS	IEC	3	0	0	0	3	2023

i) COURSE OVERVIEW

Goal of this course is to expose the students to the fundamental concepts and components of Remote Sensing and Geographical Information System (GIS) and enable them to use them for various engineering applications.

ii) COURSE OUTCOMES

After the completion of the course, the student will be able to:

CO 1	Explain the principles of remote sensing and GIS	Understand
CO 2	Explain the use of digital image processing techniques for remote sensing and GIS	Understand
CO 3	Apply GIS techniques for solving complex engineering applications	Apply
CO 4	Make use of principles of remote sensing in various engineering problems	Apply

iii) SYLLABUS

Concepts of Remote Sensing- Energy interactions in the atmosphere, Atmospheric influence on spectral response patterns

Digital Image Processing– Image rectification and restoration, Image histogram, Image enhancement, Image classification, Accuracy assessment, land use/ land cover mapping, Digital Elevation Models – SRTM, LIDAR Techniques

Concepts of GIS - Components of GIS, DBMS – Geospatial data representation (Raster, Vector)- Sources of GIS data Raster geospatial data analysis - Output functions of raster geoprocessing– Vector GIS analysis functions- GIS Data Processing, Analysis and Modeling

GIS Applications: Applications of GIS in Environmental problems, Application of GIS in Transportation Planning, Highway Engineering, Traffic Engineering, disaster mitigation and management

Application of Remote Sensing with respect to land use and land cover, soil type and soil moisture monitoring, hydrological modelling and watershed management, urban growth and transportation planning, disaster mitigation and management

iv) a) TEXTBOOKS

1) Chun-Peng Lo, &Albert K. W. Yeung, Concepts and Techniques of Geographic Information Systems, 2nd edition, Pearson Education Canada, 2007. ISBN: 978-0132772643.
2) Michael N. Demers, Fundamentals of Geographic Information Systems, 4th edition, Wiley India Pvt. Ltd., 2008. ISBN: 978-0470129069.
3) Peter A.Burrough, Rachel A. McDonnell(1998), Principles of Geographical Information Systems, 2nd edition, Oxford University Press. ISBN: 978-0198233656.
4) Paul A. Longley, Michael F. Goodchild, David J. Maguire & David W. Rhind (2005), Geographical Information Systems: Principles, Techniques, Management and Applications, 2nd edition, Wiley. ISBN: 978-0470872763.

b) REFERENCES

1) Peter A. Burrough, Principles of Geographical Information Systems, 3rd edition, Oxford University Press, 2015. ISBN: 978-0198548646.
2) Clarke, K., Getting Started with Geographic Information Systems, 5th edition, Pearson Education, 2011. ISBN: 978-0321776788.
3) Michael N. Demers, Fundamentals of Geographic Information Systems, 5th edition, John Wiley & Sons, 2018. ISBN: 978-1118872932.
4) Jeffrey Star& John Estes, Geographical Information System – An Introduction, 2nd edition, Prentice Hall, 2019. ISBN: 978-0131203466.
5) D. F. Marble, H.W. Calkins & Peuquet, Basic Readings in Geographic Information Systems, Sped System Ltd., 2009. ISBN: 978-0849324162.

V) COURSE PLAN

Module	Contents	No. of hours
I	Concepts of Remote Sensing Concepts and foundations of remote sensing, Energy sources and radiation principles, Energy interactions in the atmosphere, Energy interaction with earth surface features-Spectral reflectance of vegetation, soil and water, Atmospheric influence on spectral response patterns	**9**

II	Digital Image Analysis Digital Image Processing– Storage formats (BSQ, BIL, BIP), Sources for Geometric and Radiometric distortions in images,Image rectification and restoration, Image histogram, Image enhancement, level slicing, contrast stretching, convolution filtering, Band ratioing (NDVI, SAVI, NDWI), Image classification– Supervised and unsupervised classification algorithms, Accuracy assessment, land use/ land cover mapping- Principal component, transformation Digital Elevation Models – SRTM, LIDAR Techniques	**9**
III	Concepts of GIS GIS- Definition, Spatial and attribute data, Components of GIS, DBMS– Geospatial data representation (Raster, Vector)- Sources of GIS data, Data input, Raster geospatial data analysis, Output functions of raster geoprocessing, Vector GIS analysis functions, Vector geoprocessing output functions GIS Data Processing, Analysis and Modeling, Raster based GIS data processing, Vector based GIS data processing, Queries, Spatial analysis, Descriptive statistics, Spatial autocorrelation, Quadrant counts and nearest neighbour analysis, Network analysis, Surface modelling, DTM.	**9**
IV	GIS Applications: Applications of GIS in Environmental problems, Application of GIS in Transportation Planning, Highway Engineering, Traffic Engineering, disaster mitigation and management	**9**
V	Application of Remote Sensing: Analysis of land surface temperature, classification of land use and land cover, development of terrain models- DEM & DTM, soil type and soil moisture monitoring, vegetation indices, hydrological modelling and watershed management, urban growth and transportation planning, disaster mitigation and management	**9**
	Total hours	**45**

VI) ASSESSMENT PATTERN

Continuous Assessment: End Semester Examination – 40: 60

	Continuous Assessment		
	Attendance	:	5 marks
	Assignments	:	15 marks
	Assessment through Tests	:	20 marks
	Total Continuous Assessment	:	**40 marks**
	End Semester Examination	:	**60 marks**
	TOTAL	:	**100marks**

VII) CONTINUOUS ASSESSMENT TEST

	No. of tests	:	02
	Maximum Marks	:	30
	Test Duration	:	1 ½ hours
	Topics	:	2 ½ modules

VIII) END SEMESTER EXAMINATION

	Maximum Marks	:	60
	Exam Duration	:	3 hours

Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23IEL42D	CIRCULAR ECONOMY FOR SUSTAINABLE DEVELOPMENT	IEC	3	0	0	0	3	2023

i) COURSE OVERVIEW

This course introduces the principles, strategies and practices of a circular economy including theoretical frameworks, case studies and technological innovations that drive the transition from a linear to a circular economy. Students will explore how circular economy models can be integrated into existing systems to promote sustainability, reduce waste and optimize resource efficiency. The course also focuses on industrial applications, legal frameworks, and the socio-economic implications of circularity. Furthermore, it aims to foster entrepreneurship and research in circular economy practices.

ii) COURSE OUTCOMES

After the completion of the course, the student will be able to:

CO 1	Explain the key concepts, principles and methodologies associated with circular economy and sustainable development	Understand
CO 2	Identify the role of circular economy in waste management, material recovery and industrial applications	Apply
CO 3	Apply circular economy principles to develop sustainable business models, product designs and industrial symbiosis strategies	Apply
CO 4	Explain the global and national policies and legal frameworks relevant to circular Economy	Understand

iii) SYLLABUS

Introduction to circular Economy, Transition from linear to circular economy

Concept of Sustainable development, Circular Sustainability, SDGs

Characteristics of circular economy

Circular design, Towards Zero Waste- Waste Management, LCA, CE Business Models, Research and Innovation

Case studies and real-world applications, Legal and policy framework

iv) a) TEXTBOOKS

1) Walter R. Stahel, The Circular Economy A User's Guide, 1st edition, Routledge, ISBN: 978-0367330620, 2019

2) Peter Lacy, Jessica Long and Wesley Spindler, The Circular Economy Handbook: Realizing the Circular Advantage, 1st edition, Palgrave Macmillan, ISBN: 978-1349959679, 2020

3) Shalini Goyal Bhalla, Circular Economy: (Re) Emerging Movement, Invincible Publisher, ISBN: 978-8194924395, 2020

4) Peter Lacy and Jakob Rutqvist, Waste to Wealth: The Circular Economy Advantage, 1st edition, Palgrave Macmillan, ISBN: 978-1137530684, 2015

b) REFERENCES

1) Franco-García, María-Laura, Jorge Carlos Carpio-Aguilar, and Hans Bressers, Towards Zero Waste: Circular Economy Boost, Waste to Resources, 1st edition, Springer International, ISBN: 978-3319929309, 2019

2) Marcello Tonelli and Nicolò Cristoni, Strategic Management and the Circular Economy, 1st edition, Taylor & Francis, ISBN: 978-0367514563, 2018

3) Sadhan Kumar Ghosh, Circular Economy: Global Perspective, 1st edition, Springer Verlag, ISBN: 978-9811510519, 2020

4) Lerwen Liu and Seeram Ramakrishna, An Introduction to Circular Economy, 1st edition, Springer, ISBN: 978-9811585098, 2021

5) Ken Webster, Circular Economy: A Wealth of Flows, 2nd edition, Zaccheus Entertainment, ISBN: 978-0992778460, 2017

V) COURSE PLAN

Module	Contents	No. of hours
I	**Introduction to Circular Economy** Linear Economy and its limitations- Economic and ecological disadvantages of linear economy, Transition from Linear to Circular Economy. Key concepts and methodologies of Circular Economy, 3R 4R 5R cycles, Circular Sustainability and Sustainable Development Goals (SDGs), Barriers and Drivers for Circular Economy implementation.	**8**
II	**Characteristics of Circular Economy** Material recovery and waste reduction- Material Collection Facility (MCF) and Resource Recovery Facility (RRF), Reducing negative externalities, Circular loops and the Butterfly diagram, Social and economic dimensions of Circular Economy, Circular Economy metrics and Key Performance Indicators (KPIs).	**9**
III	**Circular Design and Innovation** Cradle to Cradle design, Sustainable Product design and manufacturing. Towards Zero waste: Waste Management and Resource	**9**

	recovery, Life Cycle Analysis, Circular Business Models, Research and innovation.	
IV	**Case Studies and Real world Applications** Business models to Circular Economy, Solid Waste Management and Wastewater Treatment, Plastics and Circular Economy, Extended Producer Responsibility (EPR) and Polluters Pays Principle, Industrial Symbiosis, Ecoparks, Circularity in urban planning and smart cities.	**10**
V	**Legal and policy framework** Role of governments and international networks, Global Circular Economy Policies (EU Green Deal, UN CE initiatives, ISO standards), India's strategy on Circular Economy, Corporate sustainability reporting (ESG, GRI, CSRD compliance), Circular Economy and sustainable finance models, Policy innovations in Circular Economy.	**9**
	Total hours	**45**

VI) ASSESSMENT PATTERN

Continuous Assessment: End Semester Examination – 40: 60

Continuous Assessment		
Attendance	:	5 marks
Assignments	:	15 marks
Assessment through Tests	:	20 marks
Total Continuous Assessment	:	**40 marks**
End Semester Examination	:	**60 marks**
TOTAL	:	**100 marks**

VII) CONTINUOUS ASSESSMENT TEST

No. of Test	:	2
Maximum Marks	:	30 marks
Test Duration	:	1.5 hours
Topic	:	2.5 modules

VIII) END SEMESTER EXAMINATION

Maximum Marks	:	**60 marks**
Exam Duration	:	3 Hours