PROGRAM:WATERRESOURCE AND ENVIRONMENTAL ENGINEERING

VISION

Tobeaknowledgecentreinwaterandlandmanagementeducation,researchandpractical fieldforcreatingsustainableenvironmentandenhancingqualityoflife.

MISSION

Developaspecializedprofessionalbyimpartingqualityeducationandtraining.Attain internationalstandardsinteaching,education,researchandconsultancy.

PROGRAMOUTCOMES

Attheendoftheprogramthestudentwillbeableto:

PO1	Analyzehydrometeorologicaldataandcomponentsofhydrologicalcycle
PO2	Assesssurfaceandgroundwaterresources
PO3	Planwaterresourcesprojectsformeetingsocio-economicaland environmentalneeds
PO4	Designandmanagewaterresourcessystemsforoptimalutilization
PO5	Managelandandwaterinthechangingclimatescenario
PO6	Analyzehydrologicextremesandadoptsuitablemanagementpracticesto minimizeimpacts
PO7	Workandleadinmultidisciplinaryenvironmentanddemonstrateprofessional andsocialethics
PO8	Engageincriticalthinkingandpursuelifelonglearningfor professionaladvancement

Semester-II

REMOTE SENSING AND GEOGRAPHICAL INFORMATION SYSTEM			
Course Code	MCWE201	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	03:02:00	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 10-12 Lab slots	Total Marks	100
Credits	04	Exam Hours	03

Course objectives:

Students will be able to know

- To understand basic concept & techniques of Remote Sensing and GIS.
- To acquire skills in image processing techniques and interpretation of remotely sensed data.
- To develop spatial database for its various application.
- To perform various spatial analysis related to water and land management.

MODULE-1

Module -1

1. Remote Sensing:

Remote Sensing Basic Principles: Introduction, Electromagnetic Remote Sensing Process, Physics of Radiant Energy: Nature of Electromagnetic Radiation, Electromagnetic Spectrum **;** Energy Source and its Characteristics, Atmospheric Interactions with Electromagnetic Radiation: Atmospheric properties, Absorption of Ozone, Atmospheric effects on Spectral Response Patterns**;** Energy interactions with Earth's surface materials: Spectral Reflectance Curves; Cossine Law.

Remote Sensing Platforms and Sensors: Satellite System Parameters, Sensor Parameter: Spatial Resolution, Spectral Resolution, Radiometric Resolution**;** Imaging Sensor Systems: Multispectral Imaging Sensor System, Thermal Sensing System, Microwave Imaging Systems; Earth Resources Satellites: Landsat Satellite Programme, SPOT Satellite, Indian Remote Sensing Satellite (IRS)**;**

Meteorological Satellites: NOAA Satellite, GOES Satellite.

Teaching-Learning Process	Black-Board Teaching, Power Point Presentation, Assignments

MODULE-2

Visual Image Interpretation: Introduction

Digital Image Processing: Introduction, Basic Character of Digital Image, Pre-processing: Geometric Correction Methods, Radiometric Geometric Correction, Atmospheric Geometric Correction**;** Image Enhancement Techniques: Contrast Enhancement**;** Spatial Filtering Techniques: Low Pass Filters, High Pass Filters, Filtering for Edge Enhancement**;** Image Transformations NDVI Transformation, PCA Transformation**;** Image Classification: Supervised Classification, Training Dataset, Unsupervised Classification.

Teaching-Learning Process	Black-Board Teaching, Power Point Presentation, Skill enhancement through problem solving. Image enhancement techniques using open source software.

MODULE-3

2. Geographical Information System:
Introduction to GIS: Introduction to GIS History of GIS, Early developments in GIS, Applications of GIS, Spatial Data Input and Editing: Primary Data, Secondary Data, and Data Editing.
Introduction: Maps and Map Scale, Map Scale, Type of Maps, Map and Glob.
Geo-referencing and Projection: Understanding Earth, Coordinate System, Map Projection, Transformation, Geo-referencing.

Teaching-Learning Process	Black-Board Teaching, Power Point Presentation, map making techniques using open sources GIS software.

MODULE-4

Global Positioning System (GPS): Introduction.
Spatial Database Management Systems: Introduction, Data Storage, Database Structure Models, Database Management system, Entity Relationship Model, Normalization.
Data Models and Data Structures: Introduction, GIS Data Model, Vector Data Structure, Raster Data structure, Geodatabase and Metadata.

Teaching-Learning Process	Black-Board Teaching, Power Point Presentation, Performing spatial analysis techniques using open sources GIS software.

MODULE 5

Spatial Analysis: Introduction to spatial analysis, Vector Operations and Analysis, Network Analysis, Raster Data Spatial Analysis.
Interpolation: Introduction to Interpolation, Global Methods of Interpolation, Local Methods of Interpolation.
Web GIS: Introduction, Web GIS, OGC & Web Services.

Teaching-Learning Process	Black-Board Teaching, Power Point Presentation, Skill enhancement through problem solving. Understanding spatial analysis techniques using open sources GIS software.

PRACTICAL COMPONENT OF IPCC

Sl. No.	Experiments
1	Familiarization with Maps of different scales (SOI Toposheets).
2	Familiarization with Monochromatic and Multispectral Satellite Imagery (Creation of FCC).
3	Ground truth collection and geotagging of sample sites using any hand-held GPS or a Mobile App.
4	Visual Interpretation of Aerial photographs & Satellite Imagery and area measurement.
5	Atmospheric & Radiometric Correction of Satellite Images.
6	Import and Export of Satellite data to various formats using different software.
7	Development of Spatial Geodatabase.
8	Spatial Data creation using field data in GIS Software environment.
9	Feature extraction (Vectorization) using GIS Software.

10	Familiarization in open source like (Q- GIS).
11	Generating the spectral reflectance of land covers using a spectroradiometer or aHyperspectral satellite RS Data.
12	Introduction to practical using Google Earth Engine

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE)is 50%. The minimum passing mark for the CIE is 50%ofthe maximum marks. Minimum passing marks in SEE is 40%ofthe maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- two Unit Tests each of **25 Marks**
- Two assignments each of **25Marks** or **one Skill Development Activity of 50marks**

To attain the Cos and POs

The sum of two tests, two assignments/skill Development Activities, will be **scaleddownto50 marks**

CIEmethods/questionpaperisdesignedtoattainthedifferentlevelsofBloom'staxonomy

As per the outcome defined for the course.

Semester End Examination:

1. TheSEEquestionpaperwillbesetfor100marksandthemarksscoredwillbe proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full questionisfor20marks.Therewill be two full questions(with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Text Books:

M. Anji Reddy, _Remote Sensing and Geographical Information Systems'4th Edition, BS Publications.

Kang-Tsung Chang, _Introduction to Geographic Information Systems', McGraw-Hill Book Company.

Reference Books:

1. Longley, P. A., Goodchild, M. F., Maguire, D. J., and Rhind, D. W., _Geographic Information Systems and Science', 2nd Edition, John Wiley and Sons.
2. Burrough, P. A., and McDonnell, R. A. _Principles of Geographical Information Systems', Oxford University Press, 2nd Edition.
3. Demers, M. N., _Fundamentals of Geographic Information Systems', John Wiley & Sons, 3rd Edition.

Web links and Video Lectures (e-Resources):

- Students are encouraged to visit SWAYAM web site where there are several Massive Open Online Courses (MOOC), http://swayam.gov.in
- ISRO-IIRS outreach programme and conducting live & Interactive courses at our Institute/Organization

Skill Development Activities Suggested

- Flipped classroom activity
- Case study analysis
- Group discussion / work

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl.No.	Description	BloomsLevel
CO-1	DevelopasoundunderstandingoftheBasicprinciplesandfunctiontechniquesofRemoteSensing& GIS.	L1,L2
CO-2	Understandvarioustechniquesinpreparingspatialdata.	L1, L3
CO-3	Designing&Manipulationofspatialdatabase.	L4, L6
CO-4	AcquiringknowledgeofSpatialDataAnalysisandVisualization	L4, L5
CO-5	Image Interpretation, Digital Image Processing, Remote Sensing Technologies	L2,L3

Mapping of COS and Pos

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	X		X			X		
CO2		X	X				X	
CO3			X	X	X			
CO4			X			X	X	X
CO5	X	X	X		X	X		

SURFACE WATER HYDROLOGY			
Course Code	**MCWE202**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	04:00:00	SEE Marks	50
Total Hours of Pedagogy	40 hrs of teaching	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- To understand components of hydrologic cycle in a catchment and to analyse the precipitation
- To estimate the abstraction components of precipitation – evapotranspiration and infiltration
- To estimate the runoff generated in a catchment and to understand hydrological modelling
- To predict flood and carry out flood routing

Module-1	
Introduction: Scope and importance of hydrology, Hydrologic cycle, Global and India's Water resources. Watershed Concept: Catchment characteristics, stream patterns Precipitation: Rainfall characteristics, Depth-Area Adjustment, Average areal rainfall, Estimating missing rainfall data, Gauge consistency.	
Teaching-Learning Process	Black board, LCD, Skill enhancement through problem solving

Module-2	
Evapo-transpiration: Factors affecting evaporation, Measurement, Transpiration, Evapotranspiration & its estimation by Penman's equation. Infiltration-Process, Factor affecting infiltration, Measurement, Horton's equation and Philip's equation. Infiltration indices.	
Teaching-Learning Process	Black board, LCD, Skill enhancement through problem solving

Module-3	
Runoff:-Process, Factors affecting runoff, Basin yield, flow duration curve, curve number method, Classification of models, Lumped parameter conceptual models, Physically based models, Model performance testing.	
Teaching-Learning Process	Black board, LCD, Skill enhancement through problem solving, Understanding hydrological models through literature review

Module-4	
Hydrograph and its features, Methods of hydrograph separation, Unit hydrograph and its derivation, Unit hydrographs from complex storms and for various durations	
Teaching-	Black board, LCD, Skill enhancement through problem solving, NPTEL course,

Learning Process	Understanding the use of UH theory for various applications through literature study

Module-5

Flood: Design flood and its estimation

Flood routing- Reservoir routing: Modified Pul's method, Goodrich method, Channel routing- Prism and Wedge storage, Muskingum method.

Teaching - Learning Process	Black board, LCD, Skill enhancement through problem solving, NPTEL course, Understanding various applications of floor routing through literature study

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. two Unit Tests each of **25Marks**
2. Two assignments each of **25Marks or one Skill Development Activity of 50marks** to attain the COs and POs

The sum of two tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module.

Suggested Learning Resources:

TextBooks

1. SubramanyaK."Engineering Hydrology", Tata McGraw Hill, 2016
2. Raghunath H. M., "Hydrology", New Age Publishers, 3rd Ed. 2018
3. Putty, M. R.Y. "Principles of Hydrology", I.K. Int. Publishing House, New Delhi,2010

Reference Books:

1. Linsley R K, Kohler and Paulhus. "Hydrology for Engineers", McGraw Hill, NY, USA,1958.
2. Mutreja, K. N. "Applied hydrology", Tata McGraw Hill Pub. Co., New Delhi, India-1986.
3. Chow, V.T. "Handbook of Applied hydrology", McGraw Hill, NY, 1964

Web links and Video Lectures (e-Resources):

- https://archive.nptel.ac.in/courses/105/105/105105214/
- https://www.aboutcivil.org/new/hydrology.html
- https://web.iitd.ac.in/~dhanya/Engineering_Hydrology.html

Skill Development Activities Suggested

- Knowing various applications of floor routing through literature study and applying the same to real time problems.
- Study of different available hydrological models through literature review and using them on possible catchment.
- Understanding the applications UH theory for various purposes and to derive UH for the catchment.

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO-1	Understand the components of hydrologic cycle in a catchment and to analyse the precipitation	L3, L4
CO-2	Estimate the abstraction components of precipitation – evapotranspiration and infiltration	L3, L4
CO-3	Estimate the runoff generated in a catchment and understand hydrological modelling	L3, L4
CO-4	Predict flood and carry out flood routing	L3, L4

Mapping of COS and Pos

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	x	x					x	
CO2		x						x
CO3			x	x	x		x	x
CO4			x	x	x	x		

WATER POLLUTION ANDCONTROL			
Course Code	MCWE203	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	03	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

1. To study the various methods and advanced techniques used in water pollution control, treatment and management.
2. To understand the domestic and industrial waste effect on the environment.
3. To understand the water and wastewater sampling techniques and monitoring methods.
4. To study the important industries and their sources of wastewater, characterization, process and It's impacts on the Environment.
5. To know the various recent trends, and technique used for water pollution control, treatment, and management.
6. To know various sustainable approaches for water and wastewater pollution control, treatment and management.
7. To study the Water Acts, laws, legislation.

Module-1

Introduction: Definition of Water Pollution, Cause and Sources, and Consequences of Water Pollution and Remedial Measures. Wastewater characteristics, Nature of pollutants, Ground water pollution – Cause, Sources and its effects on environment and Remedial Measures.

Water and wastewater Management: Treatment process flowchart of water and wastewater

Industrial Waste Effects: On Sewage Treatment Plant and Receiving Water Bodies, Present Scenario of River and Lake Pollution in India. Self-Purification of Streams. Effluent Standards and Stream Standards.

Trace pollutants:Toxic trace elements in natural water and wastewater, organic trace pollutants and their analysis

Field Visits: Water And Waste Water Treatment Plant.

(To Understand The Process And Treatment Of Waste Water)

Teaching-Learning Process	Black-Board Teaching, Power Point Presentation, Solving numerical, Assignments

Module-2

Wastewater Sampling -: Existing approaches of control on water quality degradation, Concept of Material Balance, wastewater Sampling techniques, Sampling Procedure, Stages and Preservation.

Natural methods of wastewater Disposal.

Water Quality Monitoring: Definition and concept of river and lake water quality monitoring and management. Water quality assessment of lake and river water.Concept of Bio-monitoring. DO and BOD in streams. Water quality monitoring in treatment plants.

Water Disinfection Process – Disinfection methodologies and their suitability. Theory of Disinfection and characteristics of good disinfectant. Forms of Chlorination, Chemical reactions, Break point Chlorination.

WaterSoftening-

Teaching-Learning Process	Black-Board Teaching, Group work and Assignments

Module-3

Unit Operations For Wastewater Treatment : Physical, chemical and biological unit process. Methods of treatment of wastewater.

Biological Treatment Miscellaneous methods : Oxidation Ditch, Stabilization Ponds, Aerobic and Anaerobic Ponds, Facultative Ponds, Aerated Lagoons, Rotating Biological Contactors, Sequencing Batch Reactor. Aerobic and Anaerobic Reactors.

Teaching-Learning Process	Black-Board Teaching, Group work and Assignments

Module-4

Point and Non-Point Source of Pollution: Point & Non – Point source pollution.
NPDES Storm water program, Nutrient pollution. National Estuary Program (NEP), Water Quality Standards, Storm water Pollution, Green Storm water Management. Polluted Runoff.
Sustainable water and wastewater management: Sustainable approaches for water treatment and wastewater treatment and management, Sustainable water infrastructure. Sustainable rural wastewater planning and management. Rural Sanitation.

Teaching-Learning Process	Black-Board Teaching, Power Point Presentation, Assignments

Module-5

Water Acts, laws, legislation- importance of Water laws & legislation – Water Act (1986), National Water Policy (CPCB). Water quality objectives and standards. Riparian rights, Groundwater ownership, Environmental Protection Law, Water pollution control acts and, Legislation in India, Control Acts, EPA , NPDES, TSCA, RCRA, drinking water and wastewater resilience.

Teaching-Learning Process	Black-Board Teaching, Power Point Presentation, Flipped classroom, Assignments

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1.two Unit Tests each of **25 Marks**

2.Two assignments each of **25 Marks** or **one Skill Development Activity of 50 marks** to attain the COs and POs

The sum of two tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Books

1. Fair, G.M., Geyer J.C and Okun, (1969) "Water and Waste water Engineering" Vol II, John Wiley Publications.
2. Weber W.J., (1975) "Physico - Chemical Processes for Water Quality Control".
3. Peavy, H.S., Rowe and Tchobonoglous,G., (1985), "Environmental Engineering", McGraw Hill.
4. ViessmanJr, Hammer J. M, Perez, E.M, and Chadik, P. A, Water Supply and Pollution Control, PHI Learning, New Delhi, 2009.
5. Howard S. Peavy, Donald R. Rowe and George Tchobanoglous, Environmental Engineering, McGraw Hill., 1984
6. Dr.B.C Punmia, arun Kumar jain, ashok Kumar jain, wastewaster engineering, environmental engineering 2, laxmi publications LT, New delhi.2022
7. W K Berry, Water Pollution, CBS Publishers & Distributors PVT.LTD,New delhi 2016

Web links and Video Lectures (e-Resources):

WeblinksandVideoLectures(e-Resources):

- https://onlinecourses.nptel.ac.in/noc22_ce27/preview
- https://archive.nptel.ac.in/content/storage2/courses/105104102/Lecture%207.htm
- https://nptel.ac.in/courses/105104102
- https://onlinecourses.nptel.ac.in/noc22_ce27/preview
- https://nptel.ac.in/courses/105106119

Skill Development Activities Suggested

- Flipped classroom activity
- Group works
- Case study analysis and field visit.

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	Understands various methods and advanced techniques used in water pollution control, treatment and management.	L1, L2,L3,L4
CO2	Understands the domestic and industrial waste effect on the environment.	L3,L4,L5
CO3	Understands the water and wastewater sampling techniques and monitoring methods	L2,L3,L4,L5
CO4	Understands the important industries and their sources of wastewater, characterization, process and It's impacts on the Environment	L4,L5,L6
CO5	Understands the various recent trends, and technique used for water pollution control, treatment, and management	L3, L4,L5
CO6	Understands various sustainable approaches for water and wastewater pollution control, treatment and management.	L4,L5,L6

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	x	x	x	X	x	x	x
CO2	x			X		x	x
CO3	x	x		X	x		
CO4		x	x		x	x	x
CO5	x	x	x	X	x	x	x
CO6	x	x	x	X	x		

Mapping of COS and POs

Semester- II

IRRIGATION ENGINEERING AND HYDRAULIC STRUCTURES [As per Choice Based Credit System (CBCS) scheme]			
Course Code	MCWE204	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	03:00:00	SEE Marks	50
Total Hours of Pedagogy	40 hrs of teaching	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- To know various techniques of irrigation and understand the water requirement of crops
- To know irrigation requirements of crops and to estimate the duration and frequency for irrigation
- To check the stability of dam and carry out the design the gravity dam.
- To analyse and design the diversion structure
- To design the stable canal system using different techniques

Module-1

Introduction: Advantages and Disadvantages of irrigation, Types & Techniques of Irrigation including advanced techniques,

Soil-Moisture-Irrigation Relationship, Estimating depth and frequency of irrigation.

Water Requirements and Irrigation Planning, Factors Affecting Irrigation Interval, Optimum Utilization of Irrigation Water, Crop Seasons in India, Effect of Water Stress on Crops.

Teaching-Learning Process	Black board, LCD, Skill enhancement through problem solving, Analysing the section of a dam for its stability.

Module-2

Multiple Cropping,Hybrid Cropping, Crop Period, Base Period, Delta of a Crop, Duty, Factors Affecting Duty, Irrigation Efficiencies, Determining Irrigation Requirement of Crops, Irrigation Scheduling.

Consumptive use of Crops- Blanney-Criddle method,Thornthwait penman method

Teaching-Learning Process	Black board, LCD, Knowing failures of dams through literature, Skill enhancement through design and stability check evaluation.

Module-3

Gravity Dam**:**Forces acting on gravity dam section, Principle and shear stresses, Modes of failures, stability analysis, high/low gravity dam, elementary/ practical profile, Gravity and Zonal method of design.

Teaching-Learning Process	Black board, LCD, Skill enhancement through the designing Ogee section of gravity dam and associated energy dissipaters, Knowing failures of diversion structures through literature study.

Module-4

Diversion Structures: Types, Causes of failure and their remedial measures, Bligh's Theory and Khosla's Theory.

Design of Vertical Drop Weir: Design of floor length and thickness for weir, Design of weir on

permeable foundation.	
Teaching-Learning Process	Black board, LCD, Design of weirs on permeable soils. Study of regulator structure across canals, Skill enhancement through the design of canal regulators
Module-5	
Canal System: Canal networks, Design of unlined channels, Kennedy's and Lacey's theory of canal design, Types of Canal falls and Canal Escapes. Types of lined canals, Design of lined canals.	
Teaching - Learning Process	Black board, LCD, Skill enhancement by doing design of canals.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. two Unit Tests each of **25 Marks**
2. Two assignments each of **25 Marks or one Skill Development Activity of 50 marks** to attain the COs and POs

The sum of two tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Text Books:

1. Modi, P.N. "Irrigation, Water Resources and Water Power Engineering" Standard Book House, New Delhi, 2nd ed, 1990.
2. Garg S.K, Irrigation Engineering and Hydraulic Structures, Khanna Publishers N.D. 2006.

Reference Books:

1. Varshney "Concrete dams"— Oxford & IBH Publications, 1978
2. Creager, Justin, Hinds. "Engineering for Dams (Volume-I, II and III)" – Wiley India

Publications.

Web links and Video Lectures (e-Resources):

- https://archive.nptel.ac.in/courses/105/105/105105110/
- https://www.vssut.ac.in/lecture_notes/lecture1424715569.pdf
- https://nptel.ac.in/courses/10510511

Skill Development Activities Suggested

- Solving problem and checking stability of dam section.
- Design of Ogee section of gravity dam and associated energy dissipaters
- Design of various components of canal regulators
- Design of canals by different methods.
- Design and stability check evaluation for weir on permeable soils.

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO-1	To know various techniques of irrigation and understand the water requirement of crops	L3 and L4
CO-2	To know irrigation requirements of crops and to estimate the duration and frequency for irrigation	L3 and L4
CO-3	To check the stability of dam and carry out the design the gravity dam.	L3 and L4
CO-4	To analyse and design the diversion structure	L3 and L4
CO-5	To design the stable canal system using different techniques	L3 and L4

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	x	x						
CO2	x	x	x					x
CO3			x	x	x	x	x	
CO4				x		x	x	
CO5				x		x	x	

GROUND WATER HYDROLOGY			
Course Code	MCWE215A	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	02:00:02	SEE Marks	50
Total Hours of Pedagogy	25 hrs of teaching +10-12 sessions of SDA	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- To understand Governing equation of Groundwater flow in Aquifer.
- To know the models for Ground Water Analysis.
- To Analysis Steady State Well Hydraulics.
- To Study Artificial Recharge of Aquifers.

Module-1

General Water Balance, Regional Ground Water Balance, Distribution of Subsurface Water, Different Types of Aquifers, Heterogeneity and Anisotropy, Occurrence of Ground Water in Hydro Geological Formations, Structure and Types
of Wells. –Problems on estimation of basic parameters.

Teaching-Learning Process	Black board, LCD, Skill enhancement through problem solving.

Module-2

Governing Equation of Groundwater Flow in Aquifers. Derivation of General Differential Equations for Ground Water Flow, Regional Ground Water Problems, Governing Equations for Transient Flow Conditions.

Teaching-Learning Process	Black board, LCD, Skill enhancement through problem solving.

Module-3

Models for Ground Water Analysis: Introduction, Major Applications of Groundwater Models, Numerical Modelling of Groundwater Systems, Groundwater Modelling by the Finite Difference (FD). –Problems.
Pollution of Groundwater: Effect of density on migration of the contaminant solution, Importance of stratigraphic information on solute movement, Effect of disersivity on solute dispersion, Effect of distribution coefficient, Time delays and aquifer cleaning, Hydrodynamic Dispersion of Pollutants in Groundwater Environment (Advection dispersion, Molecular diffusion)
Optimization models for management of groundwater quantity and quality.

Teaching-Learning Process	Black board, LCD, Skill enhancement through problem solving.

Module-4

Well Hydraulics: Analysis of Steady Radial Flow Towards a Well in a confined Aquifer, DupuitForcheimmer (DF) Theory of free Surface Flow For Steady Flow in Unconfined Aquifers, Analysis of Steady Radial Flow in Laterally Stratified Phreatic
Aquifers. Problems on well Hydraulics.

Teaching-LearningProcess	Blackboard,LCD,Skillenhancementthroughproblemsolving.

Module-5

ArtificialRecharge: Spreadingmethods,Induced-rechargemethod,Recharge-wellmethod,Subsurfacedams,Wastewaterdischarge,Rechargeby urbanstormrunoff,Casehistory.
GeophysicalMethodsinGroundwaterExploration,Introduction,ElectricalResistivityMethod,AnalyticalDerivationforResistivityinVerticalElectricalSounding,SeismicRetractionMethod,DeterminationofAquiferThickness, GeologicandHydrologicmethods,Hydrogeologicwelllogging,Tracertechniques.

Teaching-LearningProcess	Blackboard,LCD,Skillenhancementthroughproblemsolving.

AssessmentDetails(bothCIEandSEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% andforSemester EndExam (SEE)is50%.TheminimumpassingmarkfortheCIEis50%ofthemaximummarks.Minimumpassingmarks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied theacademicrequirementsandearnedthecreditsallottedtoeachsubject/courseifthestudentsecuresnotlessthan50% (50marksoutof100)inthesumtotaloftheCIE(ContinuousInternalEvaluation)andSEE(SemesterEndExamination) takentogether.

ContinuousInternalEvaluation:

1. Two UnitTestseachof **25 Marks**
2. Twoassignmentseachof **25 Marks**or**oneSkillDevelopmentActivityof 50 marks**

ToattaintheCOsandPOs

Thesumofthreetests,twoassignments/skillDevelopmentActivities,willbe**scaleddownto50marks**

CIEmethods/questionpaperisdesignedtoattainthedifferentlevelsofBloom'staxonomyaspertheoutcome definedforthe course.

SemesterEndExamination:

1. TheSEEquestionpaperwillbesetfor100marksandthemarksscoredwillbeproportionatelyreducedto50.
2. Thequestionpaperwillhavetenfullquestionscarryingequalmarks.
3. Eachfullquestionisfor20marks.Therewillbetwofullquestions(withamaximumoffoursub-questions)fromeachmodule.
4. Eachfullquestionwillhaveasub-questioncoveringallthetopicsunderamodule.

Thestudentswillhavetoanswerfivefullquestions,selectingonefullquestionfromeachmodule.

SuggestedLearningResources:

TextBooks:

1.A.K.Rastogi.,NumericalGroundwaterHydrology,PenramInternationalPublishing(India)Pvt.Ltd.2007.

ReferenceBooks:

1. ToddD.K.&Mays,L.W.,"GroundWaterHydrology",3Ed,Wiley
2. RaghunathH.M.,"GroundWater",NewAgePublishers,2007.
3. FittsC.,GroundwaterScience,AcademicPress,(2012).
4. BearJ.,HydraulicsofGroundwater,DoverPublications,(2007).

WeblinksandVideoLectures(e-Resources):

- Students are encouraged to visit SWAYAM web site where there are severalMassiveOpenOnlineCourses(MOOC),http://swayam.gov.in
- Studentsareencouragedto takethebenefitsof SWAYAMPRABHA-thedirecttohome(DTH)34channelstelecastingeducational programmeson24x7basisusingGSAT-15satellite.Thechannelsareup-linkedfromBISAG-N,Gandhinagar.

Courseoutcome(CourseSkillSet)

Attheendofthecoursethestudentwillbeableto:

Sl. No.	Description
CO-1	UnderstandGoverningequationofGroundwaterflowinAquifer.
CO-2	KnowthemodelsforGroundWaterAnalysis.

CO-3	AnalysisSteadyStateWellHydraulics.
CO-4	StudyArtificialRechargeofAquifers

MappingofCOSandPos

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	x	x			x			
CO2		x	x	x				
CO3	x	x		x	x	x		
CO4	x	x	x	x			x	x

Semester- 2

URBAN FLOOD MANAGEMENT [As per Choice Based Credit System (CBCS) scheme]			
Course Code	MCWE215B	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	02:00:02	SEE Marks	50
Total Hours of Pedagogy	40 hrs of teaching	Total Marks	100
Credits	03	Exam Hours	03

Course Learning objectives:

- To understand the types and characteristics of urban flooding
- To understand the key climate uncertainties and expected consequences of climate change
- To acquire the knowledge of urban water cycle, flood damages, loss of life estimation and flood risk maps
- To understand the concept of sustainable flood response, IFRM, SPR model, NIPP
- To know the application of SUDS systems and FFWRS

Module-1	
Introduction: The influence of climate, causes of flooding, types of flooding, fluvial/pluvial flooding, principles of landuse planning Climate Change: Key uncertainties and Robust Findings: A review of the past, signs of change, Expected consequences.	
Teaching-Learning Process	Black-Board Teaching, Power Point Presentation, Illustrative Videos, Assignments
Module-2	
Hydrology of cities: Urban hydrological cycle, Land use & runoff, Urban flood risk assessment, Tangible & intangible damages, Loss of life estimation in flood risk assessment, flood risk mapping	
Teaching-Learning Process	Black-Board Teaching, Power Point Presentation, Solving numerical, Assignments
Module-3	
Responding to Flood Risk: Responses, Resilience, Vulnerability, Robustness & Sustainability, SPR Model, Confronting flood management with land use planning, Building types, infrastructure & public open spaces	
Teaching-Learning Process	Black-Board Teaching, Power Point Presentation, Group works, Assignments
Module-4	
Urban drainage systems: A historical perspective, Major & Minor flows, SUDS/LIDS, Practices in water sensitive urban design Enhancing coping & recover capacity: Flood forecasting warning and response, Emergency Planning, Management & Evacuation	

Teaching-Learning Process	Black-Board Teaching, Power Point Presentation, Group works, Assignments

Module-5

Disaster mitigation & Management: Modes of disaster management, primary & secondary data, EIA of flood management structures, traffic management during floods, socio-economic studies, interdepartmental cooperation, Regional & global disaster mitigation measurement.

Teaching - Learning Process	Class seminars, Power Point Presentation, Group works

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. two Unit Tests each of **25 Marks**
2. Two assignments each of **25 Marks** or **one Skill Development Activity of 50 marks** to attain the COs and POs

The sum of two tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Text Books

1. Chris Zevenbergen, AdraianCashman, Erik Pasche and Richard Ashely. Urban Flood Management, CRC Press-2010 Edition.
2. Richard Ashley, Stephen Garvin, Erik Pasche, Andreas Vassilopoulos, Chris Zevenbergen. Advances in Urban Flood Management, CRC Press-2007 Edition.

Reference Books

1. Wheater, H. S., Mcintyre, N., Jackson, B. M., Marshall, M. R., Ballard, C., Bulygina, N. S., Reynolds, B. and Frogbrook, Z. Multiscale Impacts of Land Management on Flooding, Wiley-Blackwell, Oxford, UK, (2010).

2. ArunKumar.Handbook of Flood Management: Flood Risk Simulation, Warning, Assessment and Mitigation, SBS Publisher, India, Vol. 1 2009.

Web links and Video Lectures (e-Resources):

- NDMA, Govt. of India: https://ndma.gov.in/Natural-Hazards/Urban-Floods
- KSNDMA, Govt. of Karnataka: https://www.ksndmc.org/
- NPTEL Materials: https://nptel.ac.in/courses/105101010
- Youtube lectures: https://www.youtube.com/watch?v=OVz4NxCKAMw

Skill Development Activities Suggested

- Flipped classroom activity
- Group works
- Solving Numerical

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO-1.	Understand the characteristics of urban flooding and implication of climate change impacts	L2
CO-2.	Assess different types of flood damages, loss of life and develop the flood risk maps	L3, L4
CO-3.	Analyze urban water cycle and plan responses for sustainable flood management	L3, L4
CO-4.	Adopt the SUDS/ WSUD techniques in urban landscapes and plan appropriate Flood forecasting, Warning and Response system	L3, L4

Mapping of COs and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	X				X	X		X
CO2		X						
CO3		X	X	X		X		X
CO4			X				X	

ADVANCEDREMOTESENSING

CourseCode	MCWE215C	CIEMarks	50
TeachingHours/Week(L:P:SDA)	03:00:00	SEEMarks	50
TotalHoursofPedagogy	40hrsofteaching	TotalMarks	100
Credits	03	ExamHours	03

CourseLearningobjectives:

- TogaintheknowledgeofdifferentPlatformsandSensors.
- Tostudytheprincipalsandapplicationofoptical,microwaveandthermalremotesensing.
- ToacquiretheskillsofImageinterpretationandanalysis.
- ToperformvariousDigitalImageprocessingtechniques.

Module-1

Introduction: Definitionof terms,Conceptsandtypesof remote sensing; evolutionof remotesensing technology,stages in remote sensingtechnology,spatialdata acquisition,interdisciplinarynatureandrelationwithotherdisciplines,applicationsofremotesensing,advantagesofRSover conventionalmethodsofsurveyandinventorying,OverviewofRS

Teaching-Learning Process	Blackboard,LCD, Literaturestudy,Skill enhancement through problem solving.Websearching,

Module-2

Basic Principles of Remote Sensing : Electromagnetic spectrum: Characteristics of electro-magneticradiation; Interactions between matter and electro-magnetic radiation; Wavelength regions of electro-magnetic radiation; Types of remote sensing with respect towavelength regions; active and passiveremotesensing,Definitionof radiometry;Blackbody radiation;Reflectance;spectral reflectanceoflandcovers;Spectralcharacteristicsofsolarradiation;Radiativetransferequation;energyinteraction intheatmosphere;energyinteractionswiththeearth‘ssurface-spectralreflectancecurves.

Teaching-Learning Process	Blackboard,LCD,Literaturestudy,Skillenhancementthroughproblemsolving.Websearching,

Module-3

Sensors: Typesofsensors-passivesensorsandactivesensors;imagingsystems,photographicsensors,characteristicsofopticalsensors;Sensorresolution-spectral,spatial,radiometricandtemporal;Dispersingelement;Spectroscopicfilter;Spectrometer;Characteristicofoptical detectors;Camerasforremotesensing;Filmforremotesensing;non-imagingradiometers,imagingsensors,photograph v/simage,Panchromatic,Multispectral,hyperspectral, stereo images, Optical mechanicallinescanner;Pushbroomscanner;Imagingspectrometer;spaceborneimagingsensors,activeandpassivemicrowavesensors;Thermalsensors;Atmosphericsensors;Sonar;Laser,radar,hyperspectral sensors.Productsfromscannerdata,Imagedatacharacteristics,dataselectioncriteria.

Teaching-Learning Process	Blackboard,LCD, Literaturestudy,Skill enhancement through problem solving.Websearching,NPTELCourses.

Module-4

Platforms: Typesof platforms-airborneremotesensing,spaceborneremotesensing;Atmosphericcondition and altitude;Attitudeofplatform;Attitude sensors; Orbital elements of satellite; Orbitofsatellite;Satellitepositioningsystems;satellitesforLand,Ocean,andatmosphericstudies

ImageInterpretationandAnalysis: Fundamentalsofsatelliteimageinterpretation;Typesofimaging,elementsofinterpretation;TechniquesofvisualinterpretationGenerationsofThematic maps.

Teaching-	Blackboard,LCD,Literaturestudy,Skillenhancementthroughproblemsolving.Web

Learning Process	searching,

Module-5

Digital Image Processing: Digital data manipulation and analysis; image rectification– Radiometriccorrection,Atmosphericcorrection,Geometriccorrection;imageenhancement– Spatialfeaturemanipulation and multi- image manipulation; classification techniques – Supervised classification andunsupervisedclassification.

Advanced Remote Sensing Technologies: Synthetic Aperture Radar; Side Looking Airborne Radar;HyperspectralImagingSpectrometer;Lidar;ThermalImagingSystem;AdvancedLaserTerrain Mapping.

Teaching-Learning Process	Blackboard,LCD, Literaturestudy,Skill enhancement through problem solving.Websearching,

AssessmentDetails(bothCIEandSEE)

The weightage of ContinuousInternal Evaluation (CIE)is 50% andfor Semester End Exam (SEE) is50%.TheminimumpassingmarkfortheCIEis50%ofthemaximummarks.Minimumpassingmarks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied theacademic requirements and earnedthe credits allotted to each subject/ course if the studentsecures notlessthan 50%(50 marksoutof 100)in the sum total of the CIE (ContinuousInternal Evaluation)andSEE(SemesterEndExamination)takentogether.

ContinuousInternalEvaluation:

1. two UnitTestseachof **25 Marks**
2. Twoassignmentseachof **25 MarksoroneSkillDevelopmentActivityof 50 marks** toattaintheCOsandPOs

The sum of two tests, two assignments/skill Development Activities, will be **scaled down to 50marks**

CIEmethods/questionpaperisdesignedtoattainthedifferentlevelsofBloom'staxonomyaspertheoutcome definedforthe course.

SemesterEndExamination:

1. TheSEEquestionpaperwillbesetfor100marksandthemarksscoredwillbeproportionatelyreducedto50.
2. Thequestionpaperwillhavetenfullquestionscarryingequalmarks.
3. Eachfullquestionisfor20marks.Therewillbetwofullquestions(withamaximumoffoursub-questions)fromeachmodule.
4. Eachfullquestionwillhaveasub-questioncoveringallthetopicsunderamodule.
5. Thestudentswillhavetoanswerfivefullquestions,selectingonefullquestionfromeach module

SuggestedLearningResources:

- Students are encouraged to visit SWAYAM web site where there are several Massive OpenOnlineCourses(MOOC),http://swayam.gov.in
- ISRO-IIRSoutreach programmeandconductinglive&Interactivecoursesat ourInstitute/Organization

TextBooks:

1. George Joseph, ―Fundamentals of Remote Sensing‖, Universities Press, 2005
2. P. J. Curran, ―Physical aspects of Remote Sensing‖, Longman Group Limited, London.

Reference Books:

1. F. F. Sabins, ―Remote Sensing Principles and Interpretation‖, Waveland Press.
2. John R Jensen ―Introductory Digital Image Processing: A Remote Sensing Perspective‖, Pearson Series Geographic Information Science, ISBN- 13: 978-0134058160
3. 3. Robert A. Schowengerdt ―Remote sensing Models and methods for image processing‖, Second edition, 1997, Academic Press.

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses

Skill Development Activities Suggested

- Literature review
- Software learning
- Case study
- Field visit
- Hands on training

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	BloomsLevel
CO-1.	Havesoundknowledgeofdifferentplatformsandsensors	L1,L2
CO-2.	Understandprincipalsandapplicationofoptical,microwaveandthermal remotesensing	L1,L2
CO-3.	PerformImageinterpretationandanalysis.	L3,L4,L5
CO-4.	PerformDigitalImageprocessingtechniques.	L3,L4,L5,L6

Mapping of COs and Pos

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	X		X	X	X			
CO2		X		X		X	X	
CO3	X	X	X			X		X
CO4	X	X	X		X	X		X

OPENCHANNELHYDRAULICS			
CourseCode	**MCWE215D**	CIEMarks	50
TeachingHours/Week(L:P:SDA)	02:00:02	SEEMarks	50
TotalHoursofPedagogy	25hrsofteaching+10-12 sessionsofSDA	TotalMarks	100
Credits	03	ExamHours	03

CourseLearningobjectives:

- TounderstandPressureandVelocitydistributionacrosschannelsection
- Tostudy thecriticaldepthandhydraulicexponentsforflowindifferentchannelsections.
- Tostudytheuniformflowthroughdifferentsectionsofprismaticchannels.
- Tounderstandthewatersurfaceprofilesundergraduallyvariedflowconditions.
- Tounderstandtheenergydissipationinhydraulicjump.

Module-1

Basic Fluid Flow in open channel: Introduction, Classification of open channels,Classification of flow, Velocity distribution, Kinetic energy and Momentum correctionfactors,Pressurevariationin-Stillwater,achannelwithsmallslope,largeslope,PressurevariationinCurvilinearflows.

Flows with small water-surface curvature, Equation of continuity, Energy equation, Momentumequation.

Teaching-Learning Process	Blackboard,LCD, Literaturestudy,Skill enhancement through problem solving.Websearching,

Module-2

EnergyDepthRelationships:Specificenergy,Criticaldepth,Calculationofthecriticaldepth forRectangular,Triangular,Circularandtrapezoidalsections,Sectionfactor,Firsthydraulicexponent.Transitions-Channelwithhump,Transitionwithachangeinwidth.

Teaching-Learning Process	Blackboard,LCD,Literaturestudy,Skillenhancementthroughproblemsolving.Websearching,

Module-3

UniformFlow:Introduction,Chezyequation, Darcy-Weisbachfriction factor, Manningsformula.Velocity distributioninwidechannelsandChannelswithsmall aspect ratio, Shearstressdistribution,Manningsroughnesscoefficient,equivalentroughness,Uniformflowcomputations-computationofnormaldepthforRectangularchannel(a.WideRectangularChannel,b.Rectangularchannelwith$y_0/B \geq 0.02$),TrapezoidalChannel, Circularchannel, Compoundsections.

Teaching-Learning Process	Blackboard,LCD, Literaturestudy,Skill enhancement through problem solving.Websearching,NPTELCourses.

Module-4

Gradually-VariedFlow:Introduction,Differentialequation,Classificationofflowprofiles,Some featuresofflowprofiles,Controlsections.Analysisofflowprofile,Transitiondepth.

Teaching-Learning Process	Blackboard,LCD, Literaturestudy,Skill enhancement through problem solving.Websearching,

Module-5	
Rapidlyvariedflow-HydraulicJump:Introduction,Themomentumequationforthejump,Classificationofjumps,Characteristicsofjumpsinarectangularchannel,Useofthejumpasan energydissipater,Locationofthejump.	
Teaching-Learning Process	Blackboard,LCD,Literaturestudy,Skillenhancementthroughproblemsolving.Websearching,

AssessmentDetails(bothCIEandSEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% andfor Semester EndExam (SEE)is50%.TheminimumpassingmarkfortheCIEis50%ofthemaximummarks.Minimumpassingmarks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied theacademic requirements and earned the credits allotted to each subject/courseif the student securesnotlessthan 50% (50marksoutof100)in the sum total of the CIE (ContinuousInternal Evaluation)andSEE(SemesterEndExamination)takentogether.

ContinuousInternalEvaluation:

1. two UnitTestseachof **25 Marks**
2. Twoassignmentseachof **25 MarksoroneSkillDevelopmentActivityof50marks** toattaintheCOsandPOs

Thesumof twotests,twoassignments/skillDevelopmentActivities,willbe**scaleddownto50marks**

CIEmethods/questionpaperisdesignedtoattainthedifferentlevelsofBloom'staxonomyaspertheoutcome definedfor the course.

SemesterEndExamination:

1. TheSEEquestionpaperwillbesetfor100marksandthemarksscoredwillbeproportionatelyreducedto50.
2. Thequestionpaperwillhavetenfullquestionscarryingequalmarks.
3. Eachfullquestionisfor20marks.Therewillbetwofullquestions(withamaximumoffoursub-questions)fromeachmodule.
4. Eachfullquestionwillhaveasub-questioncoveringallthetopicsunderamodule.
5. Thestudentswillhavetoanswerfivefullquestions,selectingonefullquestionfromeachmodule

SuggestedLearningResources:

TextBooks

1. K.Subramanya,FlowinOpenChannels,TATAMcGRAWHILLPublishingCompanyLimited,NewDelhi.
2. Chaudhry,M.H., Open Channel Flow,Prentice-Hall,EnglewoodCliffs,NewJersy,USA,1993.
3. K.G.RangaRaju,Flowthroughopenchannels,TATAMcGRAWHILLPublishingCompanyLimited,New Delhi

ReferenceBooks:

1. Chow,V.T.,"OpenChannelHydraulics",McGraw-Hill,NewYork,USA,1959.
2. Henderson,F.M.,OpenChannelFlow,Mcmillan,NewYork,1966.
3. Rouse,H.,EngineeringHydraulics,JohnWiley,NewYork,1950.
4. French,R.H.,Openchannelhydraulics,McGrawHillBookCo.,NewYork,1985

WeblinksandVideoLectures(e-Resources):

- https://nptel.ac.in/courses/105/106/105106114/

SkillDevelopmentActivitiesSuggested

- Skillenhancementthroughproblemsolving,
- Skillenhancementthroughwebsearching,
- SkillenhancementthroughattendingNPTElcourses.

Courseoutcome(CourseSkillSet)

Attheendofthecoursethestudentwillbeableto:

Sl. No.	Descriptio n	Blooms Level
CO-1	SketchthePressureandVelocitydistributionacrossvarious channelsections	L1,L2,L3,L4
CO-2	Determinecriticaldepthandhydraulicexponentsforflowthroughvariouschannels ections.	L2,L3,L4
CO-3	Estimatenormaldepthunderuniformflowconditionthroughdifferentprismaticcha nnelssections.	L2,L3,L4
CO-4	Sketchthewatersurfaceprofilesundergraduallyvariedflowconditions.	L1,L2,L3,L4,L 5
CO-5	Estimatetheenergydissipationinhydraulicjump.	L2,L3,L4,L5

MappingofCOsandPos

	PO1	PO4	PO5	PO6	PO7	PO8
CO1	×	-	×	×	-	-
CO2	×	×	×	×	×	-
CO3	-	×	×	×	×	-
CO4	-	×	-	×	×	×
CO5	×	×	×	×	×	-

INDUSTRIAL SAFETY, HEALTH AND ENVIRONMENTAL MANAGEMENT			
Course Code	**MCWE216A**	CIEMarks	50
Teaching Hours/Week(L:P:SDA)	02:00:02	SEE Marks	50
TotalHoursofPedagogy	40 hours teaching	Total Marks	100
Credits	03	Exam Hours	03

Course learning objectives:

1. This course enables students to learn the basic principles of safety, OSHA act and the national policy.
2. It gives knowledge on cause-effect relationships of accidents at work places, need for economics and ergonomics, hazard identification and control aspects, fire prevention and control.
3. Workplace health relate disease recovered.

Module-1

Introduction – concept and scope of occupational safety and environmental health, basic requirements for a healthy environment and environmental quality, human exposure and impact of environmental factors on health.

Occupational Safety and Health Occupational Health and Safety Administration- Laws governing OSHA and Right to know, National Safety Law, types of diseases and their spread, Health Emergency.

Teaching-Learning Process	Chalk and Talk, PowerPoint Presentation and Video Lecture

Module-2

Ergonomics at work place-Preventing ergonomic hazards, Ergonomic task analysis, Ergonomic standards, and Ergonomic programs.

Occupational hazard and control–Hazard analysis, Human error and fault tree analysis, Emergency response, Principles of Safety.

Teaching-Learning Process	Chalk and Talk, PowerPoint Presentation and Video Lecture.

Module-3

Fire prevention and protection–fire triangle, fire development and its severity, effect of enclosures, early detection of fire, classification of fire and fire extinguishers.

Electrical safety, Productsafety-safe handling of chemicals, safety procedures of nuclear installations.

Teaching-Learning Process	Chalk and Talk, PowerPoint Presentation and Video Lecture

Module-4

Accidents–causation, investigation, methods of acquiring accident facts, supervisory role in accident investigation.

Personal protective equipment–types and advantages, effects of exposure and treatment for engineering industries, municipal solid waste. Environment management plans (EMP) for safety and sustainability.

Teaching-Learning Process	Chalk and Talk, PowerPoint Presentation and Video Lecture

Module-5

Occupational health and safety considerations.

Water and wastewater treatment plants, handling of chemicals and safety measures in water and wastewater treatment plants and labs, Construction material manufacturing industries like cement plants, RMC plants, precast plants and construction sites. Policies, roles and responsibilities of workers, managers and supervisors.

Teaching-Learning Process	Chalk and Talk, PowerPoint Presentation and Video Lecture

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. two Unit Tests each of **25 Marks**
2. Two assignments each of **25 Marks** or **one Skill Development Activity of 50 marks**

to attain the COs and POs

The sum of two tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

SuggestedLearningResources:

Books

1. GoetschD.L.,(1999),"OccupationalSafetyandHealthforTechnologists, EngineersandManagers",PrenticeHall.
2. CollingD.A.,(1990),"IndustrialSafetyManagementandTechnology",PrenticeHall,NewDelhi.
3. Della D.E.,andGiustina,(1996),"SafetyandEnvironmentalManagement",Van4.NostrandReinhold InternationalThomsonPublishingInc.BiomedicalWaste(HandlingandManagement)Rules
4. Trevethick, R.A., ((1973), "Environmental and Industrial Health Hazards"- William 10. HeinemannMedical Books Ltd., London

WeblinksandVideoLectures(e-Resources):

- **.https://nptel.ac.in/courses/114106017**
- **https://youtu.be/8nbOI-0U9Co**
- **https://youtu.be/Be9inw8xlw8**
- **https://youtu.be/n7oUOUCIblg**

SkillDevelopmentActivities Suggested

Visit to nearby industries to understand Industrial Safety, Health And Environmental Management planning.

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5
CO1	X	X	X	X	X
CO2	X	X	X	X	X
CO3	X	X	X	X	X
CO4	X	X		X	X
CO5	X	X	X	X	X

INTEGRATED SOLID WASTE MANAGEMENT			
CourseCode	**MCWE216B**	CIEMarks	50
TeachingHours/Week(L:P:SDA)	02:00:02	SEEMarks	50
Total Hours of Pedagogy	25 hrs of teaching +10-12sessions of SDA	TotalMarks	100
Credits	03	ExamHours	03

CourseLearningobjectives:

1. Toprovidedetailedknowledgeandskillsandprovideemployabilityinsolidwastemanagement.
2. Toprovidedetailedknowledgeofcollection,treatment,disposalandrecyclingoptionsforsolidwastes.
3. Toprovidedetailedknowledgeofprinciplesofexistingandemergingtechnologies for the treatmentofwasteandrecoveryofvaluefromwaste.

Module-1

Evolution of Solid Waste management – SWM, ISWM, consequence, waste generation, development of SWM & ISWM, Operation of SWM System and its problems.
Legislative trends and impacts- Federal legislation, Governmental Agencies, future trends.

Teaching-Learning Process	Blackboard,LCD, Literaturestudy,Skill enhancement through the design problemsonerosionestimation.

Module-2

Sources, composition and Properties of solid waste: Types of material recovered from MSW, future changes in waste composition. Physical. Chemical and biological properties of MSW.
Sources, types and properties of hazardous waste found in MSW.
Solid waste Generation and collation rates, Waste handling and separation, storage and processing at the source. Engineering Classification.
Collection of Solid Waste-Types ofwaste collection, collection services, collection systems, collection equipment,andCollectionRouteOptimization.

Teaching-Learning Process	Blackboard,Byaudio-Visualfacility,LCD,Literaturestudy,Skillenhancementbyproblemsolving.

Module-3

Transfer and Transport- Transfer Stations, Location and factors of Transfer Stations, Transfer Means and Methods.
Separation And Processing And Transformation Of Solid Waste: reuse and recycle, MRFs Biological And Chemical Conversion Technologies: Aerobic composting and Anaerobic composting. Chemical Transformation Process, Energy production from biological conversion products.

Teaching-Learning Process	Blackboard,Byaudio-Visualfacility,LCD,Literaturereview.

Module-4

Thermal Conversion Technologies: fundamentals Combustion process. Incinerator and its types, pyrolysis, gasification, plasma gasification, energy recovery system.
Materials Separation And Processing Technologies: Unit operations, size reduction, size separation, density separation, magnetic and electric separation, densification.
Disposal method of SW using sanitary landfill : Landfill methods, types, factors, classification,

landfilldesign,landfilloperation,landfillclosureandpostclosureplan.Leachateandleachate treatment.	
Teaching-Learning Process	Blackboard,Byaudio-Visualfacility,LCD,Literaturereview,NPTELlectures.

Module-5

Other Type of Solid Waste: Biomedical waste management, Industrial waste management, E waste management, radioactive waste management, hazardous waste management .
Solid waste management and planning issues : 3 R, strategies for meeting diversion goals, Sources reduction, implementation of solid waste management options, planning siting and permitting ofwastemanagement facilities.

Teaching-Learning Process	Blackboard,Byaudio-Visualfacility,LCD,Literaturereview,NPTELlectures.

Assessment Details (both CIE and SEE)
The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. two Unit Tests each of **25 Marks**
2. Two assignments each of **25Marks** or **one Skill Development Activity of50marks** to attain the COs and POs

The sum of two tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**
CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

SuggestedLearningResources:

TextBooks

1. TchobanoglousG.,TheissenH.,andEliassenR.,"SolidWasteEngineeringPrinciplesandManagement Issues",McGrawHill,NewYork.
2. H.S.Peavy,D.R.Rowe,G.Tchobanoglous.EnvironmentalEngineering,Mcgrow-HillInternationalEdition,1stEdition,2013.
3. Georgetechobanoglous,HilaryT,SamuelA.V."IntegratedSolidWasteManagement"engineeringprinciplesand,managementissues.McGrawHill,Indiaprivatelimited.NewDelhi.

ReferenceBooks:

1. MantelC.L.,(1975),"SolidWasteManagement",JohnWiley
2. PavoniJ.L.,"HandbookofSolidWasteDisposal".

WeblinksandVideoLectures(e-Resources):

https://nptel.ac.in/courses/

SkillDevelopmentActivitiesSuggested

- Skillenhancementthroughtheproblemsolving.
- SkillenhancementbyproblemsolvingonSWMissues,casestudyanalysis.

Courseoutcome(CourseSkillSet)

Attheendofthecoursethestudentwillbeableto:

Sl. No.	Descriptio n	BloomsLevel
CO-1.	Understandandapplythebasicscientificandsustainabilityprinciples behind waste management,forsolvingpracticalwastemanagementchallenges.	L1,L2,L3,L4,L5,L6
CO-2.	Understand the fundamental principles of existing and emerging Technologiesforthetreatmentofwasteandrecoveryofvaluefromwaste.	L1,L2,L3,L4, L5,L6
CO-3.	Adoptsuitabletechniques,methodstosolve solidwastemanagement problems.	L1,L2,L3,L4, L5,L6

MappingofCosandPos

	PO1	PO2	PO3	PO5	PO7	PO8
CO1	X		X	X	X	X
CO2		X		X	X	X
CO3	X	X	X	X	X	X

WASTE WATER RECLAMATION AND REUSE			
Course Code	**MCWE216C**	CIEMarks	50
Teaching Hours/Week (L:P:SDA)	03:00:00	SEEMarks	50
Total Hours of Pedagogy	40 hrs of teaching	TotalMarks	100
Credits	03	ExamHours	03

CourseLearningobjectives:

1. To provide a basic description and understanding of Wastewater Reclamation and Reuse and the principal unit processes used in the treatment of wastewater.
2. To understand the scientific basis of each unit process, as well as the conventional approach to their engineering design.
3. To provide an understanding of the Reuse of Wastewater Using Aerobic and Anaerobic Reactor.
4. To provide an understanding of the theoretical principles and design of physical and biological treatment methods.
5. To provide an understanding of the risk assessment, legal aspects, and health aspects in wastewater reclamation and reuse and advanced wastewater treatment.
6. To provide an understanding of the recent advancements in wastewater reclamation and reuse, as well as rural wastewater systems.

Module-1

Objectives of wastewater Reclamation, Reuse and Treatment: Sources of wastewater, properties and Characteristics of wastewater, General aspects of wastewater reclamation and reuse, Reclaimed wastewater Quality, criteria, standard, guidelines. Unit Operation for wastewater and Treatment. Preliminary, Primary, Secondary Treatment, Biological Treatment and Miscellaneous Methods.

Teaching-Learning Process	Blackboard,LCD,Literaturestudy,Websearching,

Module-2

Reuse Of Wastewater Using Aerobic And Anaerobic Reactor. Concept of reactors used for Wastewater Treatment. Types of Reactor, Classification of Reactors, Working Principle, Merits , Demerits, Limitation , Treatment Efficiency, Field Application for Reuse of wastewater for various purposes.

Teaching-Learning Process	Blackboard,LCD,Literaturestudy,Websearching,

Module-3

Theoretical principles and design of Physical Treatment Methods: Screens, equalization basin, grit chamber, primary and secondary settling tanks.

Theoretical principles and design of Biological Treatment Methods: Suspended growth system - conventional activated sludge process and its modifications. Attached growth system – trickling filter, bio-towers and rotating biological contactors. Principles of stabilization ponds.

Teaching-Learning	Blackboard,LCD,Literaturestudy,Websearching,

Process	
Module-4	
Advanced Wastewater Treatment: Need and technologies used. Nitrification and De-nitrification Processes, Phosphorous Removal., Ultra-filtration, Ammonia Stripping, Wastewater Disinfection. Risk Assessment, Legal Aspects, Health Aspects in wastewater Reclamation and Reuse.	
Teaching-Learning Process	Blackboard,LCD,Literaturestudy,Websearching,
Module-5	
Recent Advancement of Wastewater Reclamation and Reuse: New polices, Role of Governmental and Non Governmental Organization, Institutional Contribution, Case Studies. Scope of research in wastewater Reclamation and Reuse. Rural wastewater systems: Septic tanks, two-pit latrines, eco-toilet, soak pits.	
Teaching-Learning Process	Blackboard,LCD,Literaturestudy,Websearching,

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. two Unit Tests each of **25Marks**
2. Two assignments each of **25Marks** or **one Skill Development Activity of 50 marks** to attain the COs and POs

The sum of twotests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

SuggestedLearningResources:

TextBooks

1. MetcalfandEddyInc.,"WastewaterEngineering-TreatmentandReuse",4thEdition,TataMcGrawHillPublishingCo.Ltd.,NewDelhi.
2. KariaG.L.,andChristianR.A.,"WastewaterTreatmentConceptsandDesignApproach", PrenticeHallofIndiaPvt.Ltd.,NewDelhi.
3. RonandL.,andDroste,"TheoryandPracticeofWaterandWastewaterTreatment",JohnWileyandSons Inc.

ReferenceBooks:

1. BenefieldR.D.,andRandalC.W.,"BiologicalProcessDesignforWastewaterTreatment", PrenticeHall,EnglewoodChiffs,NewJersey.
2. LeeC.C.,andLinS.D.,"HandbookofEnvironmentalEngineeringCalculations",McGrawHill,NewYork.
3. "IndustrialSafetyandPollutionControlHandbook",NationalSafetyCouncilandAssociate(Data)PublishersPvt.Ltd.
4. "Handbookof WastewaterReclamation and Reuse",1st Edition,Donald R. Rowe,IsamMohammedAbdel-Magid

WeblinksandVideoLectures(e-Resources):

- https://nptel.ac.in/courses/105105178
- https://nptel.ac.in/courses/105107207

SkillDevelopmentActivitiesSuggested

- Skillenhancementthroughwebsearching,
- SkillenhancementthroughattendingNPTELcourses.

Courseoutcome(CourseSkillSet)

Attheendofthecoursethestudentwillbeableto:

Sl. No.	Description	Blooms Level
CO-1.	Adopt appropriate treatment methods for municipal and certain industrial effluents and management of wastewater treatment plants, as well as the simple design equations for water and wastewater treatment plants.	L1,L2,L3,L4
CO-2.	Design and operation of wastewater treatment plants and the management of residuals from water and wastewater treatment.	L1,L2,L3,L4,L5
CO-3.	The complete understanding of the recent advancements in wastewater reclamation and reuse, as well as rural wastewater systems.	L1,L2,L3
CO-4.	Implementation of risk assessment, legal aspects, and health aspects with respect to wastewater reclamation and reuse and advanced wastewater treatment.	L1,L2,L3,L4,L5,L6
CO-5.	To design the physical, chemical, and biological reactors for the treatment, reuse, and recycle of wastewater.	L1,L2,L3,L4,L5

Mapping of COs and Pos

	PO1	PO2	PO4	PO5	PO6	PO7	PO8
CO1	**X**	**X**	**X**	**X**	X	X	X
CO2	**X**		**X**	**X**	X	X	X
CO3		**X**	**X**	**X**	X		X
CO4	**X**	**X**	**X**		X	X	X
CO5	**X**	**X**	**X**	**X**	X	X	

RENEWABLEENERGY AND ALTERNATIVE FULES			
Course Code	**MCWE216D**	CIEMarks	50
TeachingHours/Week (L:P:SDA)	02:00:02	SEE Marks	50
TotalHours ofPedagogy	40 hours	Total Marks	100
Credits	03	ExamHours	03

CourseLearningobjectives:

1. To create awareness in students about the importance of alternative fuels.
2. To teach combustion and emission characteristics of various gaseous and liquid alternative fuels.
3. To teach adaptability of engines to alternative fuels.

Module-1

Introduction to energy and resources – Renewable energy sources - Availability of solar energy – Sun-earth relationships - - Solar radiation measurement – Flat plate collectors – Solar waterheating systems – Evacuated Tubular Concentrators - Solar air heating systems and applications – Conceptsonsolardrying,cooking,desalination,solarpondsandsolarcooling-Passiveheating Andcoolingofbuildings–BasicsofsolarconcentratorsandtypesSolarthermalpower generation.

(8hrs)

Teaching-Learning Process	ChalkandTalk,PowerPointPresentationandVideo Lecture.

Module-2

Biomass to energy conversion processes – Anaerobic digestion, process parameters, biogas composition, digester types, high rate anaerobic conversion systems – Alcohol from biomass – Biodiesel: preparation, characteristicsand application – Biomasscombustionand powergeneration – Briquetting – Gasification: Process, types of gasifiers, applications – Waste to energy technologies.

(8hrs)

Teaching-Learning Process	Chalk and Talk, Power Point Presentation and Video Lecture.

Module-3

Power in the wind - Types of wind mills – WEG components, Power curves and energy estimation– Indian wind potential. Small Hydro Power: Types, site identification, head and flow measurement, discharge curve, estimation of power potential and system components. Technologies for harnessing renewable energy sources like geothermal, wave, tidal and ocean thermal energy.

(8hrs)

Teaching-Learning Process	Chalk and Talk, PowerPoint Presentation and Video Lecture

Module-4

Fossil fuels and their availability - Potential alternative liquid and gaseous fuels - Merits and demerits of various alternative fuels - Engine requirement. Methods of production - Properties - Blends of gasoline and alcohol - Performance in SI engines – Adaptability - Combustion and emission characteristics - Performance in CI engines - Emission characteristics - Properties of alcohol esters. Production and properties of CNG, LPG, hydrogen gas, biogas and producer gas - Performance and Storage, distribution and safety aspects**.**

(8hrs)

Teaching-Learning Process	Chalk and Talk, PowerPoint Presentation and Video Lecture.

Module-5

Various vegetables oils - Properties - Esterification - Performance and emission characteristics - Bio-diesel: Feed stock, characteristics, preparation (lab and commercial), storage, applications, environmental impacts, economics, policy.

(8hrs)

Teaching-Learning Process	Chalk and Talk, PowerPoint Presentation and Video Lecture

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. two Unit Tests each of **25 Marks**
2. Two assignments each of **25 Marks** or **one Skill Development Activity of 50marks** to attain the COs and POs

The sum of two tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

SuggestedLearning Resources:

Books

1. Frank Kreith and D.YogiGoswami (2007), Handbook of Energy Efficiency and Renewable Energy, CRC Press.
2. John Twidell and Tony Weir (2006), Renewable Energy Resources, 2nd Edition, Taylor & Francis, USA.
3. John A. Duffie and William A. Beckman (2006),
4. Solar Engineering of Thermal Process, 3rd Edition, John Wiley & Sons.
5. Gilbert M. Masters (2004), Renewable and Efficient Electric Power Systems, Wiley Interscience.
6. Osamu Hirao and Richard Pefley (1988), Present and Future Automotive Fuels, Wiley Interscience Publication, New York
7. Alcohols and Motor Fuels: Progress in Technology - Series No. 19 - SAE Publication USA

WeblinksandVideoLectures(e-Resources):

- https://www2.tulane.edu/~sanelson/eens1110/energy.htm
- https://www.eia.gov/energyexplained/biomass/
- https://www.iberdrola.com/sustainability/renewables-energy-wind-power
- https://www.hydropower.org/iha/discover-types-of-hydropower
- https://www.britannica.com/science/fossil-fuel

SkillDevelopmentActivities Suggested

Visit to the nearby renewable energy plants

Courseoutcome(CourseSkill Set)

At the end of the course the student will be able to :

Sl.No.	Description	Blooms Level
CO1	Learn the need for alternative fuels. Characteristics of fuels.	L1
CO2	Learn sources of various alternative fuels.	L1,L2,L3
CO3	An understanding of the limitations of fossil fuels and combustion.	L2,L3

Mapping of COs and Pos

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	X	X		X	X	X
CO2	X	X	X			X
CO3	X	X	X	X	X	X

HYDRO-SOIL ENGINEERING LABORATORY [As per Choice Based Credit System (CBCS) scheme]			
Course Code	**MCWEL207**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	01:02:00	SEE Marks	50
Credits	02	Exam Hours	03

Course objectives:

1. To Analysis the hydraulic properties of the soil.
2. To Measure and quantify flow and sediment yield in open streams.
3. To Analysis the sub-surface formation.
4. To Analysis the properties of plastic material using in micro-irrigation.

Sl.NO	Experiments
1	Determination of infiltration rate using Double ring infiltrometer.
2	Determination of flow in open stream.
3	Determination of sediment yield of the watershed.
4	Determination of ET using actual weather data and comparison with atmometer.
5	Determination of sub-surface formation using electrical resistivity method.
6	Measurement of Mean Emission Rate of Emitting tube
7	Determination of Tensile Strength & Elongation of Lateral
8	Determination of Melt Flow Index
	Demonstration Experiments (For CIE) if any
9	Carbon Black Dispersion test. & Carbon black content test-
10	Resistance of emitting tube to hydrostatic pressure at ambient/ elevated temperature
11	Reversion Test
12	Resistance to Pull outs of Joints between fitting and emitting tube.

Course outcomes (Course Skill Set):

On completion of this laboratory studies students are able to:

1. Analysis the hydraulic properties of the soil.
2. Measure and quantify flow and sediment yield in open streams.
3. Analysis the sub-surface formation.
4. Analysis the properties of plastic material using in micro-irrigation.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 40%of maximum marks in the semester-end examination(SEE). In total of CIE and SEE student has to secure 50% maximum marks of the course.

Continuous Internal Evaluation (CIE):

CIE marks for the practical course is **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled downed to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 01 tests for 100 marks, test shall be conducted after the 14th week of the semester
- In test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- **The test marksis scaled down to 20 marks** (40% of the maximum marks).

The Sum of **scaled-down** marks scored in the report write-up/journal and marks of test is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

SEE marks for the practical course is 50 Marks.

SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University.

- All laboratory experiments are to be included for practical examination.
- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.
- Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.
- Evaluation of test write-up/ conduction procedure and result/viva will be conducted

jointly by examiners.

- General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)
  - Change of experiment is allowed only once and 10% Marks allotted to the procedure part to be made zero. The duration of SEE is 03 hours

Suggested Learning Resources:

- Students are encouraged to visit SWAYAM web site where there are several Massive Open Online Courses (MOOC), http://swayam.gov.in
- Students are encouraged to take the benefits of SWAYAM PRABHA- the direct to home (DTH) 34 channels telecasting educational programmes on 24x7 basis using GSAT-15 satellite. The channels are up-linkedfrom BISAG-N, Gandhinagar.