Title of Course:	**:**	**GIS and Remote Sensing (2 + 1)**			
Course Code	**:**	CET401			
Semester	**:**	7th			
Technology	**:**	Civil Engineering Technology			
Effective	**:**	22 – Batch and onwards			
Pre-requisite	**:**	Nil			
Co-requisite	**:**	Nil			
Assessment	**:**	**Theory**		**Practical**	
	:	Quizzes/Test (s): 05 Marks Assignments/Projects/Presentations : 05 Marks Mid Semester Exam: 15 Marks Final Semester Exam: 25 Marks		Lab Rubrics: 30 % Open Ended Lab/Mini Project : 20 % Final Exam; Objective Test*: 30 % Final Exam; Conduct of Practical/Viva Voce*: 20 % *Appearance in Final Exams is mandatory	
Credit Hours/week	**:**	**Th**	2	**Pr**	1
Minimum Contact Hours	**:**	**Th**	32	**Pr**	48
Marks	**:**	**Th**	50	**Pr**	50

After Completing the Course, each student will be able to:

Sr. No.	Theory/ Practical	CLO	Taxonomy Level	PLO
1	Theory	**EXPLAIN** the basics of geographic information systems (GIS) for acquiring data to be used in different fields	C2	1
2	Theory	**DISCUSS** Remote Sensing as modern tool to acquire data	C2	11
3	Practical	**PRACTICE** use of Conventional and Advanced Surveying tools for acquiring data	P4	11

Relevant Program Learning Outcomes (PLOs):

The course is designed so that students will achieve the following PLOs:

1	Engineering Technology Knowledge:	√	7	Environment and Sustainability:	
2	Problem Analysis:		8	Ethics:	
3	Design/Development of Solutions:		9	Individual and Team Work:	
4	Investigation:		10	Communication:	
5	Modern Tool Usage:		11	Project Management:	√
6	The Engineering Technologist & Society:		12	Lifelong Learning:	

OBJECTIVES:

- Understand the fundamental principles of GIS and Remote Sensing.
- Apply GIS and Remote Sensing techniques to analyze and solve civil engineering problems.
- Familiarize students with the ArcGIS platform and its applications.

COURSE CONTENTS:

- Introduction to geographic information systems (GIS) and remote sensing
- Use of GIS to accumulate primary and secondary spatial data for generating required maps
- Manage and analyze digital data in raster and vector formats
- Data storage, editing and retrieval techniques used in a GIS
- Spatial Data Analysis, Spatial queries and selections, Overlay operations (buffer, clip, intersect, etc.), Network analysis and routing
- Cartographic principles of scale, resolution, projection, and data management to a problem of a geographic nature
- Introduction to Remote Sensing: Definition, principles, and types of remote sensing platforms (satellites, aircraft, drones).
- Overview of different types of sensors (optical, thermal, radar) and their applications.
- Image acquisition process, geometric and radiometric corrections, and image enhancement techniques.
- Visual interpretation techniques supervised and unsupervised classification methods.
- Object-based image analysis, change detection, and time-series analysis.

PRACTICAL WORK TO BE CARRIED OUT:

1. Introduction to GIS software (e.g., ArcGIS, QGIS), Basic interface navigation and toolbars.
2. Data loading and layer management for GIS software.
3. Performing spatial analysis tasks such as proximity analysis, overly analysis, and network analysis.
4. To plot a geographic grid of graph paper from collected data (manual).
5. To survey a geographic area by using Handheld GPS device.
6. Practice to creating shape file and spatial database files from available data.
7. Familiarization with Remote Sensing software (e.g., ERDAS Imagine, ENVI), User interface, data management, and basic functionality
8. Visual interpretation of satellite imagery and aerial photos, Supervised and unsupervised classification exercises Accuracy assessment techniques
9. Visual interpretation of satellite imagery and aerial photos Supervised and unsupervised classification exercises Accuracy assessment techniques
10. Visual interpretation of satellite imagery and aerial photos Supervised and unsupervised classification exercises Accuracy assessment techniques
11. Open ended lab

Recommended Books

1. Qihao Weng. (2012). An Introduction to Contemporary Remote Sensing, 1st Ed, McGraw-Hill, U. K.
2. Law, Michael, Collins, Amy (2013). Getting to Know ArcGIS for Desktop for ArcGIS 10.1 (3rd/e). ESRI Press.

3. Campbell, James B. (2011). Introduction to Remote Sensing, 5th Ed. The Guilford Press.
4. Gibson, P. J (2000). Introductory Remote Sensing: Principles and Concepts Rutledge.
5. Lillesand, T. M. & Kiefer, R. W. (2010). Remote Sensing and Image Interpretation, 6th edition. John Wiley and Sons Inc.

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	Board of Faculty	Res. No. 3.1	Dated: 19/08/2024
	Academic Council	Res. No.108.4(i)	Dated: 31-10-2024

Title of Course:	**:**	**Ground Improvement Techniques (2 + 1)**			
Course Code	**:**	CET402			
Semester	**:**	7^{th}			
Technology	**:**	Civil Engineering Technology			
Effective	**:**	22 – Batch and onwards			
Pre-requisite	**:**	Nil			
Co-requisite	**:**	Nil			
Assessment	**:**	**Theory**		**Practical**	
	:	Quizzes/Test (s): 05 Marks Assignments/Projects/Presentations: 05 Marks Mid Semester Exam: 15 Marks Final Semester Exam: 25 Marks		Lab Rubrics: 30 % Open Ended Lab/Mini Project : 20 % Final Exam; Objective Test*: 30 % Final Exam; Conduct of Practical/Viva Voce*: 20 % *Appearance in Final Exams is mandatory	
Credit Hours/week	**:**	**Th**	2	**Pr**	1
Minimum Contact Hours	**:**	**Th**	32	**Pr**	48
Marks	**:**	**Th**	50	**Pr**	50

After Completing the Course, each student will be able to:

Sr. No.	Theory/ Practical	CLO	Taxonomy Level	PLO
1	Theory	**EXPLAIN** various soil improvement techniques, their applications.	C2	1
2	Practical	**PERFORM** various lab experiments e.g. shear strength, proctor and CBR on stabilized soil.	P3	4

Relevant Program Learning Outcomes (PLOs):

The course is designed so that students will achieve the following PLOs:

1	Engineering Technology Knowledge:	√	7	Environment and Sustainability:	
2	Problem Analysis:		8	Ethics:	
3	Design/Development of Solutions:		9	Individual and Team Work:	
4	Investigation:	√	10	Communication:	
5	Modern Tool Usage:		11	Project Management:	
6	The Engineering Technologist & Society:		12	Lifelong Learning:	

OBJECTIVES:

- To understand various soil improvement techniques, their applications.

COURSE CONTENTS:

Principles and methods of ground improvement Surface Compaction; Deep Compaction; Vibro-Flotation; Preloading; Prefabricated Vertical Drains; Vacuum Drainage; Mechanically Stabilized Earth (Reinforced Earth), Granular Piles; Micro-Piles; Lime Stabilization; Cement Stabilization; Chemical Stabilization; Grouting; Geotextiles; Geo-synthetics and their uses ; Geo-reinforcement such as Geotextile and Geo- grid

RACTICAL WORK TO BE CARRIED OUT:

Related Field Visits including the following;

- soil compaction,
- stabilization by lime/cement/chemical,
- use and manufacturing of geotextiles/reinfor cement Open ended lab on soil stabilization

Recommended Books

1. Holtz, Christopher, and Berg, Geosynthetic Engineering, Bitech Publishers Ltd., Canada. (Latest Edition)
2. Bo and Choa Reclamation & Ground Improvement, Thomson Publishers, Singapore. (Latest Edition)

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Title of Course:	**:**	**Design Assessment Tools (1 + 1)**			
Course Code	**:**	CET403			
Semester	**:**	7th			
Technology	**:**	Civil Engineering Technology			
Effective	**:**	22 – Batch and onwards			
Pre-requisite	**:**	Nil			
Co-requisite	**:**	Nil			
Assessment	**:**	**Theory**		**Practical**	
	:	Quizzes/Test (s): 05 Marks Assignments/Projects/Presentations: 05 Marks Mid Semester Exam: 15 Marks Final Semester Exam: 25 Marks		Lab Rubrics: 30 % Open Ended Lab/Mini Project : 20 % Final Exam; Objective Test*: 30 % Final Exam; Conduct of Practical/Viva Voce*: 20 % *Appearance in Final Exams is mandatory	
Credit Hours/week	**:**	**Th**	1	**Pr**	1
Minimum Contact Hours	**:**	**Th**	16	**Pr**	48
Marks	**:**	**Th**	50	**Pr**	50

After Completing the Course, each student will be able to:

Sr. No.	Theory/ Practical	CLO	Taxonomy Level	PLO
1	Theory	**EXPLAIN** different approaches for the design assessment.	C2	1
2	Practical	**DEVELOP** engineering structures using digital assessment tool, considering safe design limits	P4	3

Relevant Program Learning Outcomes (PLOs):
The course is designed so that students will achieve the following PLOs:

1	Engineering Technology Knowledge:	√	7	Environment and Sustainability:	
2	Problem Analysis:		8	Ethics:	
3	Design/Development of Solutions:	√	9	Individual and Team Work:	
4	Investigation:		10	Communication:	
5	Modern Tool Usage:		11	Project Management:	
6	The Engineering Technologist & Society:		12	Lifelong Learning:	

OBJECTIVES:

To understand different approaches for the design assessment.

COURSE CONTENTS:

Introduction

Requirements of low-cost, energy-efficient building design and construction methods that utilize more renewable resources. digital prototypes of buildings, Sustainability performance of buildings through analyses before construction. Early-stage design revise decisions at the conceptual design level, Value Engineering Analysis during design

Digital tool for construction safety design

Construction Hazard Assessment with Spatial and Temporal Exposure, Construction job safety analysis and evaluation of operational risk levels using advanced software such as BIM, Computer image generation for job simulation for job safety analysis using Virtual Reality.

Decision Support System (DSS)

Assisting the monitoring and control of operations using advanced software such as GIS, Safety Analysis of Building in Construction for assessing the Structural analysis and safety using Sensors and IoT based solutions, Structural Health Monitoring tools and analysis methods.

Applications of remote sensing in civil engineering, Introduction to Image sensing, cracking analysis using image sensing, Infrastructure management, Critical infrastructure protection, detailed geographic information, Landslide prediction and analysis, construction requirements, Data handling

RACTICAL WORK TO BE CARRIED OUT:

Practical will be based on design class using suitable digital design assessment tool like BIM etc.

Recommended Books

1. The Impact of Building Information Modelling by Ray Crotty
2. BIM and Construction Management: Proven Tools, Methods, and Workflows by Brad Hardin, Dave McCool, Willey Online
3. Essential Principles of Image Sensors by- O'Reilly Media, 1st Edition

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Title of Course:	**:**	**Building Code and Compliance (3 + 0)**			
Course Code	**:**	CET404			
Semester	**:**	7th			
Technology	**:**	Civil Engineering Technology			
Effective	**:**	22 – Batch and onwards			
Pre-requisite	**:**	Nil			
Co-requisite	**:**	Nil			
Assessment	**:**	**Theory**		**Practical**	
	:	Quizzes/Test (s): 10 Marks Assignments/Projects/Presentations: 10 Marks Mid Semester Exam: 30 Marks Final Semester Exam: 50 Marks		N.A	
Credit Hours/week	**:**	**Th**	3	**Pr**	0
Minimum Contact Hours	**:**	**Th**	48	**Pr**	0
Marks	**:**	**Th**	100	**Pr**	0

After Completing the Course, each student will be able to:

Sr. No.	Theory/ Practical	CLO	Taxonomy Level	PLO
1	Theory	**JUSTIFY** selection of design code for various functions.	C2	1
2	Theory	**DEMONSTRATE** different structures of various natures and importance in compliance with the standard codes of practices.	C3	3

Relevant Program Learning Outcomes (PLOs):
The course is designed so that students will achieve the following PLOs:

1	Engineering Technology Knowledge:	√	7	Environment and Sustainability:	
2	Problem Analysis:		8	Ethics:	
3	Design/Development of Solutions:	√	9	Individual and Team Work:	
4	Investigation:		10	Communication:	
5	Modern Tool Usage:		11	Project Management:	
6	The Engineering Technologist & Society:		12	Lifelong Learning:	

Objectives:
To understand different structures of various natures and importance in compliance with the standard codes of practices

COURSE CONTENTS:

Specifications codes and Practices:

- ACI-318-14
- ASCE-07
- Pakistan Building Codes (PBC)
- IBC
- AASHTO

Choice and forms of Structures for various conditions. Drawing office Practice for preparation of detailed working drawing. Analysis design and preparation of working drawings of steel and concrete structures.

Code Compliance Policies and Procedures: Policy description, Prioritizing Code Cases, Problem Oriented Policing Program, Performance Measures, Records Organization and Electronic File Naming, Initial Steps, Investigation, and Informal Efforts to Obtain Voluntary Compliance and Correction of Violations, Scope of Inspection and Expectation of Privacy, Consent, Documentation, Inspection Warrants, Officer Safety - Basic Officer Safety Rule, Expectations, Avoiding Conflict, and Reporting.

Recommended Books

- Design of structures by R.H Nilson
- ACI-318-14
- ASCE-07
- Building Code of Pakistan – Seismic Provisions (Latest Edition)
- S.R.O. for "Application for Building Code of Pakistan" (Latest Edition)
- Building Code of Pakistan- Energy Provisions – (Latest Edition)
- S. R. O. 249 (I) for Building Code of Pakistan- Energy Provisions – (Latest Edition)
- Pakistan Electric – Telecommunication Safety Code (PETSAC) – (Latest Edition)
- S. R. O. 716 (I) for Pakistan Electric & Telecommunication Safety Code (PETSAC) (Latest Edition)
- S. R. O. 717 (I) for Pakistan Electric & Telecommunication Safety Code (PETSAC) (Latest Edition)
- Building Code of Pakistan- Fire Safety Provisions – (Latest Edition)
- S.R.O. 1073 (1) for Fire Safety Provisions – (Latest Edition)

Note: Each specialty related structural design based on codes and standard will be taught by respective specialist, like building, highway, water retaining structures and foundation design.

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Title of Course:	**:**	**Smart Technologies for Facilities Management (2 + 1)**			
Course Code	**:**	CET405			
Semester	**:**	7th			
Technology	**:**	Civil Engineering Technology			
Effective	**:**	22 – Batch and onwards			
Pre-requisite	**:**	Nil			
Co-requisite	**:**	Nil			
Assessment	**:**	**Theory**		**Practical**	
	:	Quizzes/Test (s): 05 Marks Assignments/Projects/Presentations : 05 Marks Mid Semester Exam: 15 Marks Final Semester Exam: 25 Marks		Lab Rubrics: 30 % Open Ended Lab/Mini Project : 20 % Final Exam; Objective Test*: 30 % Final Exam; Conduct of Practical/Viva Voce*: 20 % *Appearance in Final Exams is mandatory	
Credit Hours/week	**:**	**Th**	2	**Pr**	1
Minimum Contact Hours	**:**	**Th**	32	**Pr**	48
Marks	**:**	**Th**	50	**Pr**	50

After Completing the Course, each student will be able to:

Sr. No.	Theory/ Practical	CLO	Taxonomy Level	PLO
1	Theory	**UNDERSTAND** facility management and role of facility manager	C2	1
2	Theory	**DEMONSTRATE** facility management application using information modeling software for facility management	C3	5

Relevant Program Learning Outcomes (PLOs):
The course is designed so that students will achieve the following PLOs:

1	Engineering Technology Knowledge:	√	7	Environment and Sustainability:	
2	Problem Analysis:		8	Ethics:	
3	Design/Development of Solutions:		9	Individual and Team Work:	
4	Investigation:		10	Communication:	
5	Modern Tool Usage:	√	11	Project Management:	
6	The Engineering Technologist & Society:		12	Lifelong Learning:	

OBJECTIVES:
To understand facility management application using information modeling software for

facility management

COURSE CONTENTS:

Introduction to Facilities Management: Objectives of FM, Key terminologies and concepts in the domain of FM, importance of good facilities management, Trends in Facility Management.

Role of Facility Manager: Responsibilities of the facility manager, Core traits and skills of a successful facilities manager.

Overview of Computer-Aided Facility Management (CAFM): Current Facility Management Technology and Technology of the (Near) Future, Trends in Technology.

Building Information Modeling for Facilities Management: Overview of Application of BIM for FM, Standards and Data Exchange, Challenges of BIM for FM, FM BIM in Practice, HVAC based modeling

Role of Geographic Information Systems in Facility Management: Enhancing FM Capabilities with GIS, GIS Data, Location, Vector Data, Raster Data, Attribute Data, Mapping for FM, Location Mapping, Thematic Mapping, Mapping Density, Mapping Change, Spatial Analysis for FM, Attribute Selection, Nearest Selection, Inside Selection, Buffering Selection, Geocoding, Access to GIS through the Internet, GIS Analysis within the Building, Mobile Technologies.

Sustainability and FM: Sustainability for Buildings, Certification for Sustainability, ENERGY STAR Building Certification, Assessment and Planning, Software for Sustainable Facilities Management, The Importance of Visualization, L~~ife Cycle Cost Analysis,~~ Carbon/Greenhouse Gas Calculations, Energy Analysis Tools and Applications, Energy management system software that monitors and controls energy consumption in buildings by analyzing data from sensors and building systems, Building Performance and Monitoring, Case Study.

Technology Management: Building Management and Automation Systems, Access and Security Management Systems, Emerging Technologies, Smart Infrastructures, IoT, Cloud Computing.

RACTICAL WORK TO BE CARRIED OUT:

1. To develop small-scale CAFM Models
2. To develop small-scale BIM Model for Facility Management of sample residential/ building construction
3. To develop small-scale GIS Model for Facility Management of sample residential/ building construction
4. To develop model on one software for Sustainable Facilities Management
5. To perform Energy Analysis of developed models
6. To calculate Life-Cycle Cost Analysis of developed models
7. To calculate emissions of Carbon/Greenhouse Gases
8. To simulate Building Performance Analysis on sample building
9. To integrate Mobile Technology(ies) with Facilities Management on previously developed models
10. Open ended lab

Recommended Books

1. Technology for Facility Managers - The Impact of Cutting-Edge Technology on Facility Management by Eric Teicholz (John Wiley & Sons, Inc.)
2. The Facility Management Handbook by David G. Cotts, Michael Lee, Published by AMACOM

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Title of Course:	**:**	**Construction Project Administration (2 + 1)**			
Course Code	**:**	CET406			
Semester	**:**	7th			
Technology	**:**	Civil Engineering Technology			
Effective	**:**	22 – Batch and onwards			
Pre-requisite	**:**	Nil			
Co-requisite	**:**	Nil			
Assessment	**:**	**Theory**		**Practical**	
	:	Quizzes/Test (s): 05 Marks Assignments/Projects/Presentations : 05 Marks Mid Semester Exam: 15 Marks Final Semester Exam: 25 Marks		Lab Rubrics: 30 % Open Ended Lab/Mini Project : 20 % Final Exam; Objective Test*: 30 % Final Exam; Conduct of Practical/Viva Voce*: 20 % *Appearance in Final Exams is mandatory	
Credit Hours/week	**:**	**Th**	2	**Pr**	1
Minimum Contact Hours	**:**	**Th**	32	**Pr**	48
Marks	**:**	**Th**	50	**Pr**	50

After Completing the Course, each student will be able to:

Sr. No.	Theory/ Practical	CLO	Taxonomy Level	PLO
1	Theory	**INTERPRET** and communicate various construction documents on site	C3	10
2	Theory	**ANALYZE** various aspects of Site Administration and Organization	C4	11
3	Practical	**APPLY** scheduling techniques like CPM	P3	2

Relevant Program Learning Outcomes (PLOs):
The course is designed so that students will achieve the following PLOs:

1	Engineering Technology Knowledge:		7	Environment and Sustainability:	
2	Problem Analysis:	√	8	Ethics:	
3	Design/Development of Solutions:		9	Individual and Team Work:	
4	Investigation:		10	Communication:	√
5	Modern Tool Usage:		11	Project Management:	√
6	The Engineering Technologist & Society:		12	Lifelong Learning:	

OBJECTIVES:

- The student should be able to understand various aspects of Site Administration and communicate various construction documents on site.

COURSE CONTENTS:

Documentation and Record Keeping at Jobsite: Overview of Project Team Responsibilities with particular reference to Site, Record Types and Content, Event and Conversation Documentation, Periodic Reports, Diaries, Logs, Accident Reports, Progress Photographs, Video Recordings, Time-lapse Photography, Progress Schedules and Schedule Updates, Cost Documentation, Labor, Material, Equipment, Correspondence, RFIs, Change Order Logs, etc., Contractual Requirement for Documentation.

Submittals, Samples and Execution Drawings:
Types; Requirements; and Review of Submittals, Execution Drawings and Samples, Procurement Schedule, Subcontractor Submittals. **Jobsite Layout and Organizing:** Material and Equipment Handling, Labor Productivity, Equipment Constraints, Site Constraints, Elements of the Jobsite Layout Plan, Material Storage, Temporary Facilities, Jobsite Offices, Jobsite Security, Perimeter Fencing, Access Roads, Signs and Barricades, Organizing Jobsite Layout.

Planning for Construction: Construction Schedules; Scheduling Methods; Bar Charts; S-Curve Scheduling; Network Diagrams; Selection of Scheduling Software.

Site Administration: Various Project Meetings, Maintaining Good Relations with Project Stakeholders, Conduct at the Project Site, Coordinating Construction Activities, Sequencing the Work on Site, Jobsite Quality Control, Testing and Inspection; Coping with Defective and Nonconforming Work; Cleaning and Construction Waste Management; Noise Control, Dust and Mud Control; Environmental Protection s; Protecting Installed Construction.

Jobsite Safety: Construction Safety & Health Programme, Plans and Policies; Jobsite Safety Plan; Safe Work Procedures; Safety Audit and Inspections, Accident Prevention; Personal Protective Equipment, Jobsite Hazard Analysis, Safety Communications; Accident Reporting and Investigation; Training; Emergency Response

Project Closeout: The Closeout Process, Settling Punch Lists, Substantial and Final Completion, Financial Closure, As-Built Drawings.

RACTICAL WORK TO BE CARRIED OUT:

Site visits to be conducted to achieve the following outcomes:

1. Development of sample Submittals
2. Development of Daily Reports and various Site Logs
3. Development of a sample Incident/ Accident Report
4. Collect and analyse Progress Photographs, Video Recordings and Time-lapse Photography
5. Development of Site Layout for Site Management
6. Development of QC documents
7. Development of Safety Documents

Computer software to be used to achieve the following:

8. Develop Project Schedules
9. Load Resources and Cost on Project Schedule
10. Using Excel to develop Sample Project Administration templates

Explore Web-Enabled Project Administration Application(s)

11. Open ended lab.`

Recommended Books

1. Construction Project Administration 10th Edition By Edward R. Fisk & Wayne D. Reynolds
2. Construction Jobsite Management 4th Edition By William R. Mincks, Hal Johnston

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Title of Course:	**:**	**Drainage Technology (3 + 0)**			
Course Code	**:**	CET407			
Semester	**:**	7th			
Technology	**:**	Civil Engineering Technology			
Effective	**:**	22 – Batch and onwards			
Pre-requisite	**:**	Nil			
Co-requisite	**:**	Nil			
Assessment	**:**	**Theory**		**Practical**	
	:	Quizzes/Test (s): 10 Marks Assignments/Projects/Presentations: 10 Marks Mid Semester Exam: 30 Marks Final Semester Exam: 50 Marks		-	
Credit Hours/week	**:**	**Th**	3	**Pr**	0
Minimum Contact Hours	**:**	**Th**	48	**Pr**	0
Marks	**:**	**Th**	100	**Pr**	0

After Completing the Course, each student will be able to:

Sr. No.	Theory/ Practical	CLO	Taxonomy Level	PLO
1	Theory	**CATEGORIZE** the situations that necessitate drainage of agricultural lands.	C4	4
2	Theory	**APPLY** principles of drainage to operate and maintain the surface and sub-surface drainage systems for sustainable agriculture and society.	C3	7

Relevant Program Learning Outcomes (PLOs):
The course is designed so that students will achieve the following PLOs:

1	Engineering Technology Knowledge:		7	Environment and Sustainability:	√
2	Problem Analysis:		8	Ethics:	
3	Design/Development of Solutions:		9	Individual and Team Work:	
4	Investigation:	√	10	Communication:	
5	Modern Tool Usage:		11	Project Management:	
6	The Engineering Technologist & Society:		12	Lifelong Learning:	

OBJECTIVES:

- To understand principles of drainage to operate and maintain the surface and sub-surface drainage systems for sustainable agriculture and society.

COURSE CONTENTS:

- **Introduction:** Causes of waterlogging, Need for drainage, Objectives of land drainage, Reclamation of waterlogged soils. **Observation wells and Piezometers:** Difference between shallow monitoring wells and piezometers, Construction, location and installation of observation wells and piezometers, Reading water levels.

- **Drainage systems:** Drainage as part of an agricultural development project, Field drainage systems, Surface and subsurface drainage systems, Combined drainage systems, Components of a drainage system, Layout of field drainage systems, Outlet of a field drainage system, discharge calculations for a drain, Slopes of field drains.

- **Surface drainage:** Land forming- Bedding, Land grading and land planning, Field drains- Design of surface drains and construction of surface drains.

- **Subsurface drainage:** Types of subsurface drainage systems, principles of subsurface drainage systems, Depth and spacing of field drains, Drainage coefficient, Pipes, Envelopes, Construction of pipe drainage systems, Construction methods, Alignment and levels, Machinery, Supervision and inspection, Interceptor drains.

Recommended Books

1. Irrigation and Drainage Practices for Agriculture, Muhammad Rafiq Choudhry, University of Agriculture Faisalabad, Pakistan, Latest Edition.
2. Modern Land Drainage, Lambert K. Smedema and Willem F. Voltman, Latest Edition.
3. Drainage Manual, Bureau of Reclamation, US Department of Interior, Latest Edition.

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Title of Course:	**:**	**Applied Hydraulics (2 + 1)**			
Course Code	**:**	CET408			
Semester	**:**	7th			
Technology	**:**	Civil Engineering Technology			
Effective	**:**	22 – Batch and onwards			
Pre-requisite	**:**	Nil			
Co-requisite	**:**	Nil			
Assessment	**:**	**Theory**		**Practical**	
	:	Quizzes/Test (s): 05 Marks Assignments/Projects/Presentations: 05 Marks Mid Semester Exam: 15 Marks Final Semester Exam: 25 Marks		Lab Rubrics: 30 % Open Ended Lab/Mini Project: 20 % Final Exam; Objective Test*: 30 % Final Exam; Conduct of Practical/Viva Voce*: 20 % *Appearance in Final Exams is mandatory	
Credit Hours/week	**:**	**Th**	2	**Pr**	1
Minimum Contact Hours	**:**	**Th**	32	**Pr**	48
Marks	**:**	**Th**	50	**Pr**	50

After Completing the Course, each student will be able to:

Sr. No.	Theory/ Practical	CLO	Taxonomy Level	PLO
1	Theory	**DISCUSS** open channel flow, dimensional analysis, similitude, and basic principles of hydraulics.	C2	1
2	Theory	**ANALYZE** various hydraulic structures in open channel flow.	C4	2
3	Practical	**CONDUCT** proficiently essential experiments related to the fundamental of open channel flow, flow types and its measurements including pipe flows and investigate processes using hydraulic machines (pumps, turbines, flow channels, etc.)	P4	4
4	Practical	**CONTRIBUTE** actively in the lab work of applied hydraulics.	A2	9

Relevant Program Learning Outcomes (PLOs):

The course is designed so that students will achieve the following PLOs:

1	Engineering Technology Knowledge:	√	7	Environment and Sustainability:	
2	Problem Analysis:	√	8	Ethics:	
3	Design/Development of Solutions:		9	Individual and Team Work:	√
4	Investigation:	√	10	Communication:	
5	Modern Tool Usage:		11	Project Management:	
6	The Engineering Technologist & Society:		12	Lifelong Learning:	

OBJECTIVES:

To analyze various hydraulic structures in open channel flow.

COURSE CONTENTS:

- **Steady Flow in Open Channels:** Introduction, velocity distribution in open channel flow, energy principles in open channel flow, uniform open channel flow, overview of open channel design, critical flow, specific energy, hydraulic jump.

- **Gradually Varied flow:** Introduction, Analysis of gradually varied flow equation, Classifications of Gradually Varied Flow, Computation of Water Surface Profiles.

- **Similitude:** Similitude in hydraulic models, similitude requirements, geometric, kinematic and dynamic similarities, dimensionless numbers and their significance.

- **Hydraulic Structures:** Elementary concept about canals, Types of head works and their layout, Weirs and barrages with their components and functions, Canal falls, Outlets, Cross drainage works, its types and functions.
- **Dams and Hydro Power Technology:** Selection of hydropower sites, Components and layout of hydropower schemes, Types of storage dams, Reservoir engineering, operation and regulation of storage reservoirs, Water hammer phenomenon, Sedimentation Problems in Reservoirs.

- **Pumps and Turbines:** Pumps: Introduction; Classification; characteristics; head delivered; specific speed; and selection. Turbine: Introduction; Types; Construction features; Operation; Efficiencies; Specific speed, and Characteristic curves.

RACTICAL WORK TO BE CARRIED OUT:

1. Measurement of water level and velocity along the channel.
2. To perform experiment on Pelton and Francis wheel to plot its characteristic curves.
3. To perform experiment on centrifugal and reciprocating pumps to plot its characteristic curves.
4. To perform test on Centrifugal Pump in parallel and in series
5. To measure major and minor head losses in pipe flow under different scenarios.
6. Flow rate measurement through changes in the channel section.

7. To analyze water hammer phenomena through water hammer apparatus.
8. To observe the hydraulic jump downstream of the regulator.
9. Measurement of the subcritical and supercritical flows in open channel.
10. Perform experiment on flume to plot Specific energy curve for uniform flow.
11. Demonstration of Flow through Sluice Gate in Open Flow Channel.
12. Relationship between backwater level and discharge level.
13. Study of the sediment transport and settling mechanisms.
14. Open ended lab.

Recommended Books

- Fundamentals of Hydraulic Engineering Systems by Robert J. Houghtalen, A. Osman Akan, Ned H. C. Hwang (Latest Edition)
- Irrigation and Hydraulic Structures: Theory, Design and Practice by Dr. Iqbal Ali and Dr. Bagh Ali, Institute of Environmental Engineering & Research, NED University of Engineering & Technology, Karachi (Latest Edition).
- Irrigation Canals by Iqtidar H. Siddiqi, Oxford University Press (Latest Edition).
- Open-Channel Flow by M. Hanif Chaudhry, Springer (Latest Edition).

Approval:	Industrial Advisory Board	Res No. 9.5	Dated: 09/05/2024
	Board of Studies	Res. No.2.4	Dated: 29/05/2024
	Board of Faculty	Res. No. 3.1	Dated: 19/08/2024
	Academic Council	Res. No.108.4(i)	Dated: 31-10-2024

Title of Course:	**:**	**Water Supply System (1 + 1)**			
Course Code	**:**	CET409			
Semester	**:**	7th			
Technology	**:**	Civil Engineering Technology			
Effective	**:**	22 – Batch and onwards			
Pre-requisite	**:**	Nil			
Co-requisite	**:**	Nil			
Assessment	**:**	**Theory**		**Practical**	
	:	Quizzes/Test (s): 05 Marks Assignments/Projects/Presentations: 05 Marks Mid Semester Exam: 15 Marks Final Semester Exam: 25 Marks		Lab Rubrics: 30 % Open Ended Lab/Mini Project : 20 % Final Exam; Objective Test*: 30 % Final Exam; Conduct of Practical/Viva Voce*: 20 % *Appearance in Final Exams is mandatory	
Credit Hours/week	**:**	**Th**	1	**Pr**	1
Minimum Contact Hours	**:**	**Th**	16	**Pr**	48
Marks	**:**	**Th**	50	**Pr**	50

After Completing the Course, each student will be able to:

Sr. No.	Theory/ Practical	CLO	Taxonomy Level	PLO
1	Theory	**INTRODUCE** basic concepts relating to the provisions of water supply.	C2	1
2	Theory	**ESTIMATE** water demand for various needs.	C4	2
3	Practical	**PERFORM** practical related to water quality.	P3	2

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3	Design/Development of Solutions:		9	Individual and Team Work:	
4	Investigation:		10	Communication:	
5	Modern Tool Usage:		11	Project Management:	
6	The Engineering Technologist & Society:		12	Lifelong Learning:	

OBJECTIVES:

- To understand the methods of determining the quantity and quality of drinking water.
- To understand the importance of water conservation and efficient use of water resources.

COURSE CONTENTS:

1. **Introduction;** Water supply systems and their importance with respect to human health. Water borne diseases. Types of impurities and their effects on human health, WHO standards for drinking wtaer.

2. **Sources of Water:** Ground and surface sources. Selection of water sources with respect to quality and quantity considerations.

3. **Estimation of Water Demand:** Water consumption. Components of water consumption. Factors affecting consumption. Fire demand. Variations in demand; average daily, maximum daily and peak hourly consumption. Design period, factors affecting design period. Population forecasting; mathematical and graphical methods of forecasting population. Population density.

4. **Distribution of Water Supply;** Intake structures; Methods of water distribution. Components and layout of water distribution system. Storage capacity of overhead reservoirs. Use of Hazen William formula for the design of water distributions systems.

5. **Contamination in Water:** Types & Sources of Water Contaminants. Removal Methods of Water Contaminants.

5. **Pipes for Water Distribution:** Types of pipes and their use in water distribution. joints, service connection, valves and fire hydrants. Layout of water distribution systems. Disinfections of old and new pipes. Waterwaste surveys and tracing of leakages. Major & minor losses in pipes.

RACTICAL WORK TO BE CARRIED OUT:

1. Determination of pH in Water.
2. Determination of Turbidity of Water.
3. Determination of Suspended Solids in Water.
4. Calculation of dosage of Chlorine in water.
5. Calculation of dosage of coagulants (i.e. Alum and etc.)
6. Detailed Study of Various Types of Valves.
7. Detailed Study of Pipe Materials in Water Supply.
8. Detailed Study of Layout of Water Distribution Systems.
9. Detailed Study of Water Supply Drawings of Any Town/City.

Recommended Books

1. Water Supply and Sewerage by E. W. Steel and L. J. McGhee. McGraw Hill, New York. (Latest Edition).
2. Water and Wastewater Technology by M. J. Hammer, John Wiley & Sons. New York, (Latest Edition).
3. Water Supply And Sanitary Engineering by S. C. Rangwala (Latest Edition).

4. Basic Environmental Technology: Water Supply, Waste Management, and Pollution Control, Fifth Edition, Nathanson. Pearson.

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