

### III Year - I Semester

S. No.	Subjects	L	T	P	Credits
1	Management Science	4	--	--	3
2	Engineering Geology	4	--	--	3
3	Structural Analysis -II	4	--	--	3
4	Design & Drawing of Reinforced Concrete Structures	4	2	--	3
5	Transportation Engineering - II	4	--	--	3
6	Concrete Technology Lab	--	--	3	2
7	Geology Lab	--	--	3	2
8	Transportation Engineering Lab	--	--	3	2
<b>Total Credits</b>					<b>21</b>

### III Year - II Semester

S. No.	Subjects	L	T	P	Credits
1	Design & Drawing of Steel Structures	4	2	--	3
2	Geotechnical Engineering - I	4	--	--	3
3	Environmental Engineering -I	4	--	--	3
4	Water Resource Engineering -I	4	--	--	3
5	<b>OPEN ELECTIVE</b> i. Electronic Instrumentation ii. Data Base Management Systems iii. Alternative Energy Sources iv. Waste water Management v. Fundamentals of Liquefied Natural Gas vi. Green Fuel Technologies	4	--	--	3
6	Geotechnical Engineering Lab	--	--	3	2
7	Environmental Engineering Lab	--	--	3	2
8	Computer Aided Engineering Lab	--	--	3	2
<b>Total Credits</b>					<b>21</b>

## DESIGN AND DRAWING OF STEEL STRUCTURES

### Course Learning Objectives:

The objective of this course is to:

- Familiarize Students with different types of Connections and relevant IS codes
- Equip student with concepts of design of flexural members
- Understand Design Concepts of tension and compression members in trusses
- Familiarize students with different types of Columns and column bases and their Design
- Familiarize students with Plate girder and Gantry Girder and their Design

### Course Outcomes:

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

- Work with relevant IS codes
- Carryout analysis and design of flexural members and detailing
- Design compression members of different types with connection detailing
- Design Plate Girder and Gantry Girder with connection detailing
- Produce the drawings pertaining to different components of steel structures

### SYLLABUS:

**UNIT – I Connections: Introduction: (a) Riveted connections** – Definition, rivet strength and capacity- Codal Provisions, **(b) Welded connections:** Introduction, Advantages and disadvantages of welding- Strength of welds-Butt and fillet welds: Permissible stresses – IS Code requirements. Design of fillet weld subjected to moment acting in the plane and at right angles to the plane of the joints.

**All units i.e. from unit II to unit-VI to be taught in Limit State Design and in Welded connections only.**

**UNIT – II Beams:** Allowable stresses, design requirements as per IS Code-Design of simple and compound beams-Curtailment of flange plates, Beam to beam connection, check for deflection, shear, buckling, check for bearing, laterally unsupported beams.

**UNIT –III Tension Members and compression members:** General Design of members subjected to direct tension and bending –effective length of columns. Slenderness ratio – permissible stresses. Design of compression members, struts etc.

**Roof Trusses:** Different types of trusses – Design loads – Load combinations as per IS Code recommendations, structural details –Design of simple roof trusses involving the design of purlins, members and joints – tubular trusses.

**UNIT – IV Design of Columns:** Built up compression members – Design of lacings and battens. Design Principles of Eccentrically loaded columns, Splicing of columns.

**UNIT – V Design of Column Foundations:** Design of slab base and gusseted base. Column bases subjected moment.

**UNIT – VI Design of Plate Girder:** Design consideration – I S Code recommendations Design of plate girder-Welded – Curtailment of flange plates, stiffeners – splicing and connections.

**Design of Gantry Girder:** impact factors - longitudinal forces, Design of Gantry girders.

**NOTE:** Welding connections should be used in Units II – VI.

The students should prepare the following plates.

Plate 1 Detailing of simple beams

Plate 2 Detailing of Compound beams including curtailment of flange plates.

Plate 3 Detailing of Column including lacing and battens.

Plate 4 Detailing of Column bases – slab base and gusseted base

Plate 5 Detailing of steel roof trusses including joint details.

Plate 6 Detailing of Plate girder including curtailment, splicing and stiffeners.

#### **FINAL EXAMINATION PATTERN:**

The end examination paper should consist of Part A and Part B. part A consist of two questions in Design and Drawing out of which one question is to be answered. Part B should consist of five questions and design out of which three are to be answered. Weightage for Part – A is 40% and Part- B is 60%.

#### **TEXT BOOKS**

1. Steel Structures Design and Practice, N. Subramanian, Oxford University Press.
2. Design of steel structures, S. K. Duggal, Tata Mc Graw Hill, New Delhi
3. Design of Steel Structures S. S. Bhavikatti, I. K International Publishing House Pvt. Ltd.

#### **REFERENCES**

1. Structural Design in Steel, Sarwar Alam Raz, New Age International Publishers, New Delhi
2. Design of Steel Structures, M. Raghupathi, Tata Mc. Graw-Hill
3. Structural Design and Drawing, N. Krishna Raju; University Press,

#### **IS Codes:**

- 1) Indian Standard Code for General Construction in Steel, 3<sup>rd</sup> revision, Indian Standards Institution, New Delhi,2008.
- 2) IS – 875, Code of practice for design loads (other than earth quake) for buildings and structures (Part-1-Part 5),Bureau of Indian standards.
- 3) Steel Tables.

These codes and steel tables are permitted to use in the examinations.

III Year - II Semester

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<b>4</b>	<b>0</b>	<b>0</b>	<b>3</b>

### **GEOTECHNICAL ENGINEERING – I**

#### **Course Learning Objectives:**

The objective of this course is:

- To enable the student to find out the index properties of the soil and classify it.
- To impart the concept of seepage of water through soils and determine the seepage discharge.
- To enable the students to differentiate between compaction and consolidation of soils and to determine the magnitude and the rate of consolidation settlement.
- To enable the student to understand the concept of shear strength of soils, assessment of the shear parameters of sands and clays and the areas of their application.

#### **Course Outcomes:**

Upon the successful completion of this course

- The student must know the definition of the various parameters related to soil mechanics and establish their inter-relationships.
- The student should be able to know the methods of determination of the various index properties of the soils and classify the soils.
- The student should be able to know the importance of the different engineering properties of the soil such as compaction, permeability, consolidation and shear strength and determine them in the laboratory.
- The student should be able to apply the above concepts in day-to-day civil engineering practice.

#### **SYLLABUS:**

**UNIT – I Introduction:** Soil formation – soil structure and clay mineralogy – Adsorbed water – Mass- volume relationship –Relative density , Mechanism of compaction – factors affecting – effects of compaction on soil properties - compaction control.

**UNIT – II Index Properties Of Soils:** Grain size analysis – Sieve and Hydrometer methods – consistency limits and indices – Various Types of soil Classifications – Unified soil classification and I.S. Soil classification.

**UNIT –III Permeability:** Soil water – capillary rise – One dimensioned flow of water through soils – Darcy’s law- permeability – Factors affecting –laboratory determination of coefficient of permeability –Permeability of layered systems. Total, neutral and effective stresses –quick sand condition – 2-D flow and Laplace’s equation - Seepage through soils – Flow nets: Characteristics and Uses.

**UNIT – IV Stress Distribution In Soils:** Stresses induced by applied loads - Boussinesq’s and Westergaard’s theories for point loads and areas of different shapes– Newmark’s influence chart – 2:1 stress distribution method.

**UNIT – V Consolidation:** Compressibility of soils – e-p and e-log p curves – Stress history – Concept of consolidation - Spring Analogy - Terzaghi’s theory of one-dimensional Consolidation – Time rate of consolidation and degree of consolidation – Determination of coefficient of consolidation ( $c_v$ ) - Over consolidated and normally consolidated clays.

**UNIT – VI Shear Strength of Soils:** Basic mechanism of shear strength - Mohr – Coulomb Failure theories – Stress-Strain behavior of Sands - Critical Void Ratio – Stress-Strain behavior of clays – Shear Strength determination- various drainage conditions.

**Text Books:**

1. Basic and Applied Soil Mechanics, Gopal Ranjan and A. S. R. Rao, New Age International Publishers.
2. Soil Mechanics and Foundation Engineering, V. N. S. Murthy, CBS publishers

**References:**

1. Fundamentals of Soil Mechanics, D. W. Taylor, Wiley.
2. An introduction to Geotechnical Engineering, Holtz and Kovacs; Prentice Hall.
3. Fundamentals of Geotechnical Engineering, B M Das, Cengage Learning, New Delhi.

III Year - II Semester

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### ENVIRONMENTAL ENGINEERING – I

#### Course Learning Objectives:

The course will address the following:

- Outline planning and the design of water supply systems for a community/town/city
- Provide knowledge of water quality requirement for domestic usage
- Impart understanding of importance of protection of water source quality and enlightens the efforts involved in converting raw water into clean potable water.
- Selection of valves and fixture in water distribution systems
- Impart knowledge on design of water distribution network

#### Course Outcomes:

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

- Plan and design the water and distribution networks and sewerage systems
- Identify the water source and select proper intake structure
- Characterisation of water
- Select the appropriate appurtenances in the water supply
- Selection of suitable treatment flow for raw water treatments

#### SYLLABUS:

**UNIT-I Introduction:** Importance and Necessity of Protected Water Supply systems, Water borne diseases, Flow chart of public water supply system, Role of Environmental Engineer, Agency activities

**Water Demand and Quantity Estimation:** Estimation of water demand for a town or city, Per capita Demand and factors influencing it - Types of water demands and its variations- factors affecting water demand, Design Period, Factors affecting the Design period, Population Forecasting.

**UNIT-II Sources of Water:** Lakes, Rivers, Impounding Reservoirs, comparison of sources with reference to quality, quantity and other considerations- Capacity of storage reservoirs, Mass curve analysis. Groundwater sources of water: Types of water bearing formations, springs, Wells and Infiltration galleries, Yields from infiltration galleries.

**Collection and Conveyance of Water:** Factors governing the selection of the intake structure, Types of Intakes. Conveyance of Water: Gravity and Pressure conduits, Types of Pipes, Pipe Materials, Pipe joints, Design aspects of pipe lines, laying of pipe lines

**UNIT-III Quality and Analysis of Water:** Characteristics of water–Physical, Chemical and Biological-Analysis of Water – Physical, Chemical and Biological characteristics. Comparison of sources with reference to quality- I.S. Drinking water quality standards and WHO guidelines for drinking water

**UNIT-IV Treatment of Water:** Flowchart of water treatment plant, Treatment methods: Theory and Design of Sedimentation, Coagulation, Sedimentation with Coagulation, Filtration

**UNIT-V Disinfection:** Theory of disinfection-Chlorination and other Disinfection methods, Softening of Water, Removal of color and odours - Iron and manganese removal –Adsorption-fluoridation and defluoridation–aeration–Reverse Osmosis-Iron exchange–Ultra filtration

**UNIT-VI Distribution of Water:** Requirements- Methods of Distribution system, Layouts of Distribution networks, Pressures in the distribution layouts, Analysis of Distribution networks: Hardy Cross and equivalent pipe methods -Components of Distribution system: valves such as sluice valves, air valves, scour valves and check valves, hydrants, and water meters–Laying and testing of pipe lines- selection of pipe materials, pipe joints

#### **Text Books**

1. Environmental Engineering – Howard S. Peavy, Donald R. Rowe, Teorge George Tchobanoglus – Mc-Graw-Hill Book Company, New Delhi, 1985.
2. Elements of Environmental Engineering – K. N. Duggal, S. Chand & Company Ltd., New Delhi, 2012.

#### **References**

1. Water Supply Engineering – P. N. Modi.
2. Water Supply Engineering – B. C. Punmia
3. Water Supply and Sanitary Engineering – G. S. Birdie and J. S. Birdie
4. Environmental Engineering, D. Srinivasan, PHI Learning Private Limited, New Delhi, 2011.

III Year - II Semester

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### WATER RESOURCES ENGINEERING-I

#### Course Learning Objectives:

The course is designed to

- introduce hydrologic cycle and its relevance to Civil engineering
- make the students understand physical processes in hydrology and, components of the hydrologic cycle
- appreciate concepts and theory of physical processes and interactions
- learn measurement and estimation of the components hydrologic cycle.
- provide an overview and understanding of Unit Hydrograph theory and its analysis
- understand flood frequency analysis, design flood, flood routing
- appreciate the concepts of groundwater movement and well hydraulics

#### Course Outcomes

At the end of the course the students are expected to

- have a thorough understanding of the theories and principles governing the hydrologic processes,
- be able to quantify major hydrologic components and apply key concepts to several practical areas of engineering hydrology and related design aspects
- develop Intensity-Duration-Frequency and Depth-Area Duration curves to design hydraulic structures.
- be able to develop design storms and carry out frequency analysis
- be able to determine storage capacity and life of reservoirs.
- develop unit hydrograph and synthetic hydrograph
- be able to estimate flood magnitude and carry out flood routing.
- be able to determine aquifer parameters and yield of wells.
- be able to model hydrologic processes

#### SYLLABUS:

**UNIT I Introduction:** Engineering hydrology and its applications, Hydrologic cycle, hydrological data-sources of data.

**Precipitation:** Types and forms, measurement, raingauge network, presentation of rainfall data, average rainfall, continuity and consistency of rainfall data, frequency of rainfall, Intensity-Duration-Frequency (IDF) curves, Depth-Area-Duration (DAD) curves, Probable Maximum Precipitation (PMP), design storm

**UNIT-II Abstractions from Precipitation:** Initial abstractions.

**Evaporation:** factors affecting, measurement, reduction

**Evapotranspiration:** factors affecting, measurement, control

**Infiltration:** factors affecting, Infiltration capacity curve, measurement, infiltration indices.

**UNIT-III Runoff:** Catchment characteristics, Factors affecting runoff, components, computation- empirical formulae, tables and curves, stream gauging, rating curve, flow mass curve and flow duration curve.

**Hydrograph analysis:** Components of hydrograph, separation of base flow, effective rainfall hyetograph and direct runoff hydrograph, unit hydrograph, assumptions, derivation of unit hydrograph, unit hydrographs of different durations, principle of superposition and S-hydrograph methods, limitations and applications of unit hydrograph, synthetic unit hydrograph.

**UNIT-IV Floods:** Causes and effects, frequency analysis- Gumbel's and Log-Pearson type III distribution methods, Standard Project Flood (SPF) and Probable Maximum Flood (MPF), flood control methods and management.

**Flood Routing:** Hydrologic routing, channel and reservoir routing-Muskingum and Puls methods of routing.

**UNIT-V Groundwater:** Occurrence, types of aquifers, aquifer parameters, porosity, specific yield, permeability, transmissivity and storage coefficient, types of wells, Darcy's law, Dupuit's equation- steady radial flow to wells in confined and unconfined aquifers, yield of a open well-recuperation test.

**UNIT VI Advanced Topics in Hydrology:** Rainfall-runoff Modelling, instantaneous unit hydrograph (IUH) - conceptual models - Clark and Nash models, general hydrological models- Chow - Kulandaiswamy model.

**Text Books:**

1. Engineering Hydrology, Jayarami Reddy, P., Laxmi Publications Pvt. Ltd., (2013), New Delhi
2. Irrigation and Water Power Engineering, B. C. Punmia, Pande B. B. Lal, Ashok Kumar Jain and Arun Kumar Jain, Lakshmi Publications (P) Ltd.

**References:**

1. Engineering Hydrology Subramanya, K, Tata McGraw-Hill Education Pvt Ltd, (2013),New Delhi.
2. Irrigation Engineering and Hydraulic Structure, Santosh Kumar Garg, Khanna Publishers.
3. Applied hydrology, Chow V. T., D. R Maidment and L.W. Mays, Tata McGraw Hill Education Pvt Ltd, (2011), New Delhi.
4. Water Resources Engineering, Mays L.W, Wiley India Pvt. Ltd, (2013).

III Year - II Semester

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>4</b>	<b>0</b>	<b>0</b>	<b>3</b>

## Electronic Instrumentation

### Open Elective

#### Learning Objectives:

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#### UNIT-I:

##### Introduction:

(a) **Measurement Errors:** Gross errors and systematic errors, Absolute and relative errors, Accuracy, Precision, Resolution and Significant figures.

(b) **Voltmeters and Multimeters:** Introduction Multi range voltmeter, Extending voltmeter ranges, Loading, AC voltmeter using Rectifiers – Half wave and full wave, Peak responding and True RMS voltmeters.

#### UNIT-II:

**Digital Instruments:**Digital Voltmeters – Introduction, DVM's based on V – T, V – F and Successive approximation principles, Resolution and sensitivity, General specifications, Digital Multi-meters, Digital frequency meters, Digital measurement of time.

#### UNIT-III:

**Oscilloscopes:**Introduction, Basic principles, CRT features, Block diagram and working of each block, Typical CRT connections, Dual beam and dual trace CROs, Electronic switch.

**Special Oscilloscopes:**Delayed time-base oscilloscopes, Analog storage, Sampling and Digital storage oscilloscopes.

#### UNIT-IV:

**Signal Generators:**Introduction, Fixed and variable AF oscillator, Standard signal generator, Laboratory type signal generator, AF sine and Square wave generator, Function generator, Square and Pulse generator, Sweep frequency generator, Frequency synthesizer.

#### UNIT-V:

**Measurement of resistance, inductance and capacitance:** Whetstone's bridge, Kelvin Bridge; AC bridges, Capacitance Comparison Bridge, Maxwell's bridge, Wein's bridge, Wagner's earth connection .

#### UNIT-VI:

**Transducers & Miscellaneous:**Introduction, Electrical transducers, Selecting a transducer, Resistive transducer, Resistive position transducer, Strain gauges, Resistance

thermometer, Thermistor, Inductive transducer, Differential output transducers, LVDT, Piezoelectric transducer, Photoelectric transducer, Photovoltaic transducer, Semiconductor photo devices, Temperature transducers-RTD, Thermocouple.

**Display devices:** Digital display system, classification of display, Display devices, LEDs, LCD displays; Bolometer and RF power measurement using Bolometer; Introduction to Signal conditioning.

**Outcomes:**

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**Text Books:**

1. Electronic Instrumentation, H. S. Kalsi, TMH, 2004.
2. Electronic Instrumentation and Measurements, David A Bell, PHI / Pearson Education, 2006.

**Reference Books:**

1. Principles of Measurement Systems, John P. Beatly, 3<sup>rd</sup> Edition, Pearson Education, 2000.
  2. Modern Electronic Instrumentation and Measuring Techniques, Cooper D & A D Helfrick, PHI, 1998.
  3. Electronic and Electrical Measurements and Instrumentation, J. B. Gupta, S. K. Kataria & Sons, Delhi.
  4. Electronics & Electrical Measurements, A K Sawhney, Dhanpat Rai & Sons, 9<sup>th</sup> edition.
- Instrumentation & Control Systems, K. Padmaraju, Y.J. Reddy, McGraw Hill Education, 2016.

# DATA BASE MANAGEMENT SYSTEMS

## Open Elective

### OBJECTIVES

- To learn the principles of systematically designing and using large scale Database Management Systems for various applications.

**UNIT-I: An Overview of Database Management,** Introduction- What is Database System- What is Database-Why Database- Data Independence- Relation Systems and Others- Summary,

**Database system architecture, Introduction-** The Three Levels of Architecture-The External Level- the Conceptual Level- the Internal Level- Mapping- the Database Administrator-The Database Management Systems- Client/Server Architecture.

### UNIT-II:

The E/R Models, The Relational Model, Relational Calculus, Introduction to Database Design, Database Design and Er Diagrams-Entities Attributes, and Entity Sets-Relationship and Relationship Sets-Conceptual Design With the Er Models, The Relational Model Integrity Constraints Over Relations- Key Constraints –Foreign Key Constraints-General Constraints, Relational Algebra and Calculus, Relational Algebra- Selection and Projection- Set Operation, Renaming – Joins- Division- More Examples of Queries, Relational Calculus, Tuple Relational Calculus- Domain Relational Calculus.

### UNIT-III:

**Queries, Constraints, Triggers:** The Form of Basic SQL Query, Union, Intersect, and Except, Nested Queries, Aggregate Operators, Null Values, Complex Integrity Constraints in SQL, Triggers and Active Database.

### UNIT-IV:

**Schema Refinement (Normalization) :** Purpose of Normalization or schema refinement, concept of functional dependency, normal forms based on functional dependency(1NF, 2NF and 3 NF), concept of surrogate key, Boyce-codd normal form(BCNF), Lossless join and dependency preserving decomposition, Fourth normal form(4NF).

### UNIT-V:

#### **Transaction Management and Concurrency Control:**

Transaction, properties of transactions, transaction log, and transaction management with SQL using commit rollback and savepoint.

Concurrency control for lost updates, uncommitted data, inconsistent retrievals and the Scheduler. Concurrency control with locking methods : lock granularity, lock types, two phase locking for ensuring serializability, deadlocks, Concurrency control with time stamp ordering : Wait/Die and Wound/Wait Schemes, Database Recovery management : Transaction recovery.

## **UNIT-VI:**

Overview of Storages and Indexing, Data on External Storage- File Organization and Indexing –Clustered Indexing – Primary and Secondary Indexes, Index Data Structures, Hash-Based Indexing – Tree-Based Indexing, Comparison of File Organization

## **OUTCOMES**

- Describe a relational database and object-oriented database.
- Create, maintain and manipulate a relational database using SQL
- Describe ER model and normalization for database design.
- Examine issues in data storage and query processing and can formulate appropriate solutions.
- Understand the role and issues in management of data such as efficiency, privacy, security, ethical responsibility, and strategic advantage.
- Design and build database system for a given real world problem

## **Text Books:**

- 1. Introduction to Database Systems, CJ Date, Pearson**
2. Data base Management Systems, Raghurama Krishnan, Johannes Gehrke, TATA McGraw Hill 3rd Edition
3. Database Systems - The Complete Book, H G Molina, J D Ullman, J Widom Pearson

## **References Books:**

1. Data base Systems design, Implementation, and Management, Peter Rob & Carlos Coronel 7th Edition.
2. Fundamentals of Database Systems, Elmasri Navrate Pearson Education
3. Introduction to Database Systems, C.J.Date Pearson Education

## ALTERNATIVE ENERGY SOURCES

(OPEN ELECTIVE)

### Learning Objectives:

- To impart the necessity of finding alternative energy sources for automobiles. To understand merits and demerits, performance characteristics of various sources of fuels and their comparison.

### UNIT-I:

**Objective: The objective is to introduce the use and the application of different fuel types and characteristics. The student will be able to understand Solar photo-voltaic conversion and working principles.**

Introduction: Need for non-conventional energy sources. Energy alternative: solar, photo-voltaic, Hydrogen, Bio mass. Electrical - their merits and demerits.

Solar photo-voltaic conversion, Collection and storage of solar energy, Collection devices, flat plate collectors, concentrating type collectors, Principles and working of photo-voltaic Conversion, Applications to automobiles.

### UNIT-II:

**Objective: The objective is to expose the student about energy from bio-mass performance characteristics.**

Energy from Bio mass: Photosynthesis, Photosynthetic oxygen production, Energy plantation. Bio gas production from organic waste, Description and types of Bio gas plants, Application and limitations - Merits and demerits performance characteristics and their comparison.

### UNIT-III:

**Objective: The objective is to expose the students to study and understand basic principles of hydrogen energy and thermo-chemical production.**

Hydrogen Energy: Properties of hydrogen, Sources of Hydrogen, Thermodynamics of water splitting production of hydrogen, Electrolysis of water, Thermal decomposition of water. Thermo-chemical production, Biochemical production.

### UNIT-IV:

**Objective: To learn various factors to be considered in hydrogen fuel usage, and to study performance. Design and study of future possibilities of electric automobiles.**

Hydrogen fuel, Storage and transportation methods, Applications to engines modifications necessary, precautions and safety measures - Performance characteristics in engine and their comparison.

Electric Automobiles: Design considerations, limitations. Opportunities for improvement Batteries, problems. Future possibilities, capacities, types, material requirement.

**UNIT-V:**

**Objective: To learn various factors to be considered in hydrogen fuel usage, study of performance. Design and study of future possibilities of electric automobiles.**

Applicability of electric cars, major parts, battery charging, HVAC, requirements, comparative use of fuel and energy;, Availability of energy for recharging; Impacts on use of fuel and energy; Impact on urban air quality, impact on price, material requirement traction motors and types.

**UNIT-VI:**

**Objective: To study the use of turbines in automobiles and Design of turbochargers for automobiles.**

Hybrid vehicle, benefits, types of HEVs, hybrid maintenance and service.

Use of turbines in cars, arrangement, control merits and de-merits, Design of turbochargers for automobiles, their usefulness on the performance, Use of fuel cells in automobiles.

**Outcomes:**

- The students completing the course will be able to understand the ever increasing quality of life. This phenomenon imposes high demand on conventional fossil fuels. Hence search for alternate fuels is a continuous phenomenon. The student will have an overview of various alternate fuels along with their merits and limitations.

**Text Books:**

1. Non-conventional Sources of Energy, G.D. Rai, Khanna Publications.
2. Electric Automobiles, William Hamilton, PHI.
3. Alternative Fuel Technology, Erjavec and Arias, Cengage Learning

**Reference Books:**

1. Solar Energy, S.P. Sukhatme, Tata McGraw Hill.
2. Energy Technology, S. Rao & B.B. Larulekar, Khamma Lab.
3. Principles of Solar Engineering, Frank Kreith& Jan F. Krieder, McGraw Hill.
4. Solar Energy -thermal Process, J.A. Duffie&W.A. Beckman, McGrawHill.

## **WASTE WATER MANAGEMENT OPEN ELECTIVE**

### **Course Learning Objectives:**

The course will address the following:

1. Enables the student to distinguish between the quality of domestic and industrial water requirements and wastewater quantity generation.
2. To impart knowledge on selection of treatment methods for industrial wastewater.
3. To know the common methods of treatment in different industries
4. To acquire knowledge on operational problems of common effluent treatment plant.

### **Course Outcomes:**

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

- a. Suggest treatment methods for any industrial wastewater.
- b. Learn the manufacturing process of various industries.
- c. Student will be in a position to decide the need of common effluent treatment plant for the industrial area in their vicinity

### **SYLLABUS:**

#### **UNIT – I**

Industrial water Quantity and Quality requirements: Boiler and cooling waters– Process water for Textiles, Food processing, Brewery Industries, power plants, fertilizers, sugar mills.

#### **UNIT – II**

Miscellaneous Treatment: Use of Municipal wastewater in Industries – Advanced water treatment - Adsorption, Reverse Osmosis, Ion Exchange, Ultra filtration, Freezing, elutriation, Removal of Iron and Manganese, Removal of Colour and Odour.

#### **UNIT – III**

Basic theories of Industrial Wastewater Management: Industrial waste survey - Measurement of industrial wastewater Flow-generation rates – Industrial wastewater sampling and preservation of samples for analysis - Wastewater characterization- Toxicity of industrial effluents-Treatment of wastewater-unit operations and processes- Volume and Strength reduction –Neutralization – Equalization and proportioning- recycling, reuse and resources recovery.

#### **UNIT – IV**

Industrial wastewater disposal management: discharges into Streams, Lakes and oceans and associated problems, Land treatment – Common Effluent Treatment Plants: advantages and suitability, Limitations and challenges- Recirculation of Industrial Wastes- Effluent Disposal Method.

## UNIT – V

Process and Treatment of specific Industries-1: Manufacturing Process and origin, characteristics, effects and treatment methods of liquid waste from Steel plants, Fertilizers, Textiles, Paper and Pulp industries, Oil Refineries, Coal and Gas based Power Plants.

## UNIT – VI

Process and Treatment of specific Industries-2: Manufacturing Process and origin, characteristics, effects and treatment methods of liquid waste from Tanneries, Sugar Mills, Distillers, Dairy and Food Processing industries, Pharmaceutical Plants.

### Text book

1. Wastewater Treatment by M.N. Rao and A.K. Dutta, Oxford & IBH, New Delhi.
2. Industrial Wastewater Treatment by KVSG Murali Krishna.
3. Industrial Wastewater treatment by A.D. Patwardhan, PHI Learning, Delhi
4. Wastewater Treatment for Pollution Control and Reuse, by Soli. J Arceivala, Shyam R Asolekar, Mc-Graw Hill, New Delhi; 3<sup>rd</sup> Edition

### References

1. Industrial Water Pollution Control by W. Wesley Eckenfelder, Mc- GrawHill, Third Edition
2. Wastewater Engineering by Metcalf and Eddy Inc., Tata McGrawhill Co., New Delhi
3. Wastewater Treatment- Concepts and Design Approach by G.L. Karia & R.A. Christian, Prentice Hall of India.
4. Unit Operations and Processes in Environmental Engineering by Reynolds. Richard, Cengage Learning.

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III Year - II Semester

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## **FUNDAMENTALS OF LIQUEFIED NATURAL GAS (OPEN ELECTIVE)**

### **Learning Objectives:**

- To impart basic knowledge of LNG and its prospective.
- To learn different liquefaction technologies of LNG.
- To have knowledge on different functional units on receiving terminals
- To analyze transportation of LNG and regasification.
- To understand HSE of LNG industry.

### **UNIT-I:**

**Introduction:** Overview of LNG industry: History of LNG industry – Base load LNG – Developing an LNG Project – World and Indian Scenario – Properties of LNG.

### **UNIT-II:**

**Liquefaction Technologies:** Propane precooled mixed refrigerant process – Description of Air products C<sub>3</sub>MR LNG process – Liquefaction – LNG flash and storage.

**Cascade process:** Description of Conoco Phillips Optimized Cascade (CPOC) process – Liquefaction – LNG flash and storage.

**Other Liquefaction Processes:** Description of Linde MFC LNG process- Precooling and Liquefied Petroleum Gas (LPG) recovery – Liquefaction and Subcooling- Trends in LNG train capacity – Strategy for grassroots plant- Offshore LNG production.

### **UNIT-III:**

**Supporting Functional Units in LNG Plants:** Gas pretreatment: Slug catcher – NGL stabilization column – Acid gas removal unit – Molecular sieve dehydrating unit – Mercury and sulfur removal unit – NGL recovery – Nitrogen rejection – Helium recovery.

### **UNIT-IV:**

**Receiving Terminals:** Receiving terminals in India – Main components and description of marine facilities – Storage capacity – Process descriptions.

Integration with adjacent facilities – Gas inter changeability – Nitrogen injection – Extraction of C<sub>2</sub><sup>+</sup> components.

### **UNIT-V:**

**LNG Shipping Industry & Major Equipment in LNG Industry:** LNG Shipping Industry: LNG fleet – Types of LNG ships – Moss – Membrane – prismatic; Cargo measurement and calculations.

Major equipment in LNG industry – Cryogenic heat exchangers: Spiral – Wound heat exchangers – Plate & fin heat exchangers – Cold boxes; Centrifugal compressors – Axial compressors – Reciprocating compressors; LNG pumps and liquid expanders – Loading Arms and gas turbines.

## **UNIT-VI:**

**Vaporizers:** Submerged combustion vaporizers- Open rack vaporizers – Shell and tube vaporizers: direct heating with seawater, and indirect heating with seawater. Ambient air vaporizers: Direct heating with ambient air – Indirect heating with ambient air.; LNG tanks.

**Safety, Security and Environmental Issues:** Safety design of LNG facilities – Security issues for the LNG industry – Environmental issues – Risk based analysis of an LNG plant.

### **Outcomes:**

Upon successful completion of this course, the student will be able to:

- Have good knowledge on LNG process.
- Classify different liquefaction techniques.
- Understand different units in LNG processing and transportation.
- Have knowledge associated with safety aspects of LNG.

### **Text Book:**

1. LNG: Basics of Liquefied Natural Gas, 1<sup>st</sup>Edition, Stanley Huang, Hwa Chiu and Doug Elliot, PETEX, 2007.  
([https://ceonline.austin.utexas.edu/petexonline/file.php/1/ebook\\_demos/lng/HTML/index.html](https://ceonline.austin.utexas.edu/petexonline/file.php/1/ebook_demos/lng/HTML/index.html).)

### **Reference Books:**

1. Marine Transportation of LNG (Liquefied) and Related Products, Richard G. Wooler, Gornell Marine Press, 1975.
2. Marine Transportation of Liquefied Natural Gas, Robert P Curt, Timothy D. Delaney, National Maritime Research Centre, 1973.
3. Natural Gas by Sea: The Development of a New Technology, Roger Rooks, Witherby, 1993.
4. Natural Gas: Production, Processing and Transport, Alexandre Rojey, Editions OPHRYS, 1997.
5. LNG: A Nontechnical Guide, Michael D'Tusiani, Gordon Shearer PennWell Books, 2007.
6. Natural Gas Transportation, Storage and Use, Mark Fennell Amazon Digital Services, Inc., 2011.
7. Liquefied Natural Gas, Walter Lowenstein Lom, Wiley 1974.
8. Liquefied Natural Gas, C. H. Gatton, Noyes, 1967.
9. Liquefied Gas Handling Principles on Ships and in Terminals, 3<sup>rd</sup> Edition, McGuire and White, Witherby Publishers, 2000.

## GREEN FUEL TECHNOLOGIES

### Learning Objectives:

The students will be imparted the knowledge of:

- Various green fuel technologies available worldwide.
- Production of Bio-ethanol from crops, molasses and cellulosic bio mass.
- Production of Bio-diesel from plant seeds, algae, and by utilizing supercritical process.
- Methane gas production utilizing bio digesters.

### UNIT-I:

**Introduction:** Plant based biofuels- World biofuels scenario- Thermochemical conversion of biomass to liquids and gaseous fuels.

### UNIT-II:

**Bioethanol from crops – Cane sugar:** Production of ethanol from molasses - Bioethanol from starchy biomass: Production of starch Saccharifying enzymes - Hydrolysis and fermentation.

### UNIT-III:

**Bioethanol from lignocellulosic biomass:** Pretreatment of the substrates-Production of Cellulases and Hemicellulases- Hydrolysis and fermentation.

### UNIT-IV:

**Biodiesel production technologies and substrates-** Lipase-catalyzed preparation of biodiesel-Biodiesel production with supercritical fluid technologies; Biodiesel from algae: Algaculture-Challenges-Algaculture for biodiesel production

### UNIT-V:

**Biodiesel from different plant seeds:** Palm oil diesel production and its experimental test on a diesel engine - Biodiesel production using karanja (pongamia pinnata) and jatropha (jatropha curcas) seed oil - Biodiesel production form rubber seed oil and other vegetable oils.

### UNIT-VI:

**Microbial production of methane:** Different types of bio-digesters and biogas technology in India.

### Outcomes:

The students will have basic knowledge on:

- What are green fuel technologies
- How bio-ethanol, bio diesel & Methane are produced from crops, cellulosic biomass, plant seeds & bio digester.

### TEXT BOOKS:

1. Hand book of Plant Based Biofuels, Ashok Pandey, CRC Press, 2009.
2. Biofuels Engineering Process Technology, Caye M. Drapcho, Nghiem Phu Nhuan, Terry H. Walker, McGraw-Hill, 2008.

**III Year - II Semester**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>0</b>	<b>0</b>	<b>3</b>	<b>2</b>

### **GEOTECHNICAL ENGINEERING LAB**

#### **Course Learning Objectives:**

The objective of this course is:

- To impart knowledge of determination of index properties required for classification of soils.
- To teach how to determine compaction characteristics and consolidation behavior from relevant lab tests; to determine permeability of soils.
- To teach how to determine shear parameters of soil through different laboratory tests.

#### **Course Outcomes:**

Upon successful completion of this course, student will be able to

- Determine index properties of soil and classify them.
- Determine permeability of soils.
- Determine Compaction, Consolidation and shear strength characteristics.

#### **SYLLABUS:**

##### **LIST OF EXPERIMENTS**

1. Specific gravity, G
2. Atterberg's Limits.
3. Field density-Core cutter and Sand replacement methods
4. Grain size analysis by sieving
5. Hydrometer Analysis Test
6. Permeability of soil - Constant and Variable head tests
7. Compaction test
8. Consolidation test (to be demonstrated)
9. Direct Shear test
10. Triaxial Compression test (UU Test)
11. Unconfined Compression test
12. Vane Shear test
13. Differential free swell (DFS)
14. CBR Test

At least **Ten** experiments shall be conducted.



**LIST OF EQUIPMENT:**

1. Casagrande's liquid limit apparatus.
2. Apparatus for plastic and shrinkage limits
3. Field density apparatus for
  - a) Core cutter method
  - b) Sand replacement method
4. Set of sieves: 4.75mm, 2mm, 1mm, 0.6mm, 0.42mm, 0.3mm, 0.15mm, and 0.075mm.
5. Hydrometer
6. Permeability apparatus for
  - a) Constant head test
  - b) Variable head test
7. Universal auto compactor for I.S light and heavy compaction tests.
8. Shaking table, funnel for sand raining technique.
9. Apparatus for CBR test
10. 10 tons loading frame with proving rings of 0.5 tons and 5 tons capacity
11. One dimensional consolidation test apparatus with all accessories.
12. Triaxial cell with provision for accommodating 38 mm dia specimens.
13. Box shear test apparatus
14. Laboratory vane shear apparatus.
15. Hot air ovens (range of temperature 50<sup>0</sup> - 150<sup>0</sup>C)

**Reference:**

1. Determination of Soil Properties, J. E. Bowles.
2. IS Code 2720 – relevant parts.

**III Year - II Semester**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>0</b>	<b>0</b>	<b>3</b>	<b>2</b>

**ENVIRONMENTAL ENGINEERING LAB**

**Course Learning Objectives:**

The course will address the following:

- Estimation some important characteristics of water and wastewater in the laboratory
- It also gives the significance of the characteristics of the water and wastewater

**Course Outcomes:**

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

- Estimation some important characteristics of water and wastewater in the laboratory
- Draw some conclusion and decide whether the water is potable or not.
- Decide whether the water body is polluted or not with reference to the state parameters in the list of experiments
- Estimation of the strength of the sewage in terms of BOD and COD

**SYLLABUS:**

**List of Experiments**

1. Determination of pH and Electrical Conductivity (Salinity) of Water and Soil.
2. Determination and estimation of Total Hardness–Calcium & Magnesium.
3. Determination of Alkalinity/Acidity
4. Determination of Chlorides in water and soil
5. Determination and Estimation of total solids, organic solids and inorganic solids and settleable solids by Imhoff Cone.
6. Determination of Iron.
7. Determination of Dissolved Oxygen with D.O. Meter & Winklers Method and B.O.D.
8. Determination of N, P, K values in solid waste
9. Physical parameters – Temperature, Colour, Odour, Turbidity, Taste.
10. Determination of C.O.D.
11. Determination of Optimum coagulant dose.
12. Determination of Chlorine demand.
13. Presumptive Coliform test.

**NOTE:** At least 10 of the above experiments are to be conducted.

**List of Equipments**

- 1) pH meter
- 2) Turbidity meter
- 3) Conductivity meter
- 4) Hot air oven
- 5) Muffle furnace
- 6) Dissolved Oxygen meter
- 7) U–V visible spectrophotometer
- 8) COD Reflux Apparatus
- 9) Jar Test Apparatus
- 10) BOD incubator
- 11) Autoclave
- 12) Laminar flow chamber
- 13) Hazen's Apparatus

**Text Books**

1. Standard Methods for Analysis of Water and Waste Water – APHA
2. Chemical Analysis of Water and Soil by KVSG Murali Krishna, Reem Publications, New Delhi

**Reference**

1. Relevant IS Codes.
2. Chemistry for Environmental Engineering by Sawyer and Mc. Carty.

III Year - II Semester

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>0</b>	<b>0</b>	<b>3</b>	<b>2</b>

### **COMPUTER AIDED ENGINEERING LABORATORY**

Learning Objectives: The objective of this course is: 1. To enhance the students knowledge and skills in engineering drawing. 2. To introduce computer aided drafting packages and commands for modeling and sketching. 3. To learn surface modeling techniques required designing and machining 4. To draw the geometric entities and create 2D and 3D wire frame models. 5. To learn various modelling techniques such as edit, zoom, cross hatching, pattern filling, rotation,etc.

outcomes: Up on completion of the course, the student shall be able to : 1. Understand the paper –space environment thoroughly 2. Develop the components using 2D and 3D wire frame models through various editing commands. 3. Generate assembly of various components of compound solids.

#### **PART-A: MANNUAL DRAFTING**

UNIT-I Objective: The knowledge of projections of solids is essential in 3D modelling and animation. The student will be able to draw projections of solids. The objective is to enhance the skills they already acquired in their earlier course in drawing of projection and sections of solids.

Projections Of Planes & Solids : Projections of Regular Solids inclined to both planes – Auxiliary Views. Sections and Sectional views of Right Regular Solids – Prism, Cylinder, Pyramid, Cone – Auxiliary views.

UNIT-II Objective: The knowledge of development of surfaces of solids is required in designing and manufacturing of the objects. Whenever two or more solids combine, a definite curve is seen at their intersection. The intersection of solids also plays an important role in designing and manufacturing. The objective is to impart this knowledge through this topic.

Development And Interpenetration Of Solids: Development of Surfaces of Right Regular Solids – Prisms, Cylinder, Pyramid Cone and their parts. Interpenetration of Right Regular Solids – Intersection of Cylinder Vs Cylinder, Cylinder Vs Prism, Cylinder Vs Cone.

UNIT-III Objective: Isometric projections provide a pictorial view with a real appearance. Perspective views provides a realistic 3D View of an object. The objective is to make the students learn the methods of Iso and Perspective views.

Isometric Projections : Principles of Isometric Projection – Isometric Scale – Isometric Views – Conventions – Isometric Views of Lines, Plane Figures, Simple and Compound Solids – Isometric Projection of objects having non- isometric lines. Isometric Projection of Spherical Parts. Transformation of Projections: Conversion of Isometric Views to Orthographic Views – Conventions.

Perspective Projections: Perspective View: Points, Lines, Plane Figures and Simple Solids, Vanishing Point Methods(General Method only).

## **PART- B COMPUTER AIDED DRAFTING**

UNIT- IV Introduction To Computer Aided Drafting: Generation of points, lines, curves, polygons, dimensioning. Types of modelling: object selection commands – edit, zoom, cross hatching, pattern filling, utility commands, 2D wire frame modelling, 3D wire frame modelling.

UNIT -V Objective: By going through this topic the student will be able to understand the paper-space environment thoroughly.

View Points And View Ports: view point coordinates and view(s) displayed, examples to exercise different options like save, restore, delete, joint, single option.

UNIT -VI Computer Aided Solid Modelling: Isometric projections, orthographic projections of isometric projections ,Modelling of simple solids, Modelling of Machines & Machine Parts.

TEXT BOOKS : 1.Engineering Graphics, K.C. john, PHI Publications 2.Engineering drawing by N.D Bhatt , Charotar publications.

REFERENCES: 1. Mastering Auto CAD 2013 or modified version and Auto CAD LT 2013or modified version – George Omura, Sybex 2. Auto CAD 2013 or modified version fundamentals- Elisemoss, SDC Publ. 3. Engineering Drawing and Graphics using Auto Cad– T Jeyapooan, vikas 4. Engineering Drawing + AutoCAD – K Venugopal, V. Prabhu Raja, New Age 5. Engineering Drawing – RK Dhawan, S Chand 6. Engineering Drawing – MB Shaw, BC Rana, Pearson 7. Engineering Drawing – KL Narayana, P Kannaiah, Scitech 8. Engineering Drawing – Agarwal and Agarwal, Mc Graw Hill 9. Engineering Graphics – PI Varghese, Mc Graw Hill 10. Text book of Engineering Drawing with auto-CAD, K.Venkata Reddy/B.S . Publications

### **Course Learning Objectives:**

The objective of this course is:

- Outline planning and the design of wastewater collection, conveyance and treatment systems for a community/town/city
- Provide knowledge of characterisation of wastewater generated in a community
- Impart understanding of treatment of sewage and the need for its treatment.
- Summarize the appurtenance in sewerage systems and their necessity
- Teach planning, and design of septic tank and imhoff tank and the disposal of the effluent from these low cost treatment systems
- Effluent disposal method and realise the importance of regulations in the disposal of effluents in rivers

### **Course Outcomes:**

By the end of successful completion of this course, the students will be able to:

- Plan and design the sewerage systems
- Select the appropriate appurtenances in the sewerage systems

- Analyze sewage and suggest and design suitable treatment system for sewage treatment
- Identify the critical point of pollution in a river for a specific amount of pollutant disposal into the river
- Suggest a suitable disposal method with respect to effluent standards.

## **SYLLABUS:**

**UNIT – I: Introduction to Sanitation** – Systems of sanitation – relative merits & demerits – collection and conveyance of waste water – sewerage – classification of sewerage systems- Estimation of sewage flow and storm water drainage – fluctuations – types of sewers - Hydraulics of sewers and storm drains– design of sewers – appurtenances in sewerage – cleaning and ventilation of sewers

**UNIT – II: Pumping of wastewater:** Pumping stations – location – components– types of pumps and their suitability with regard to wastewaters.

**House Plumbing:** Systems of plumbing-sanitary fittings and other accessories–one pipe and two pipe systems – Design of building drainage

**UNIT – III: Sewage characteristics** – Sampling and analysis of wastewater - Physical, Chemical and Biological Examination-Measurement of BOD and COD - BOD equations  
Treatment of sewage: Primary treatment-Screens-grit chambers-grease traps–floatation–sedimentation – design of preliminary and primary treatment units.

**UNIT – IV: Secondary treatment:** Aerobic and anaerobic treatment process-comparison.  
**Suspended growth process:** Activated Sludge Process, principles, designs, and operational problems, modifications of Activated Sludge Processes, Oxidation ponds, Aerated Lagoons.  
**Attached Growth Process:** Trickling Filters–mechanism of impurities removal-classification–design-operation and maintenance problems. RBCs, Fluidized bed reactors

**UNIT V: Miscellaneous Treatment Methods:** Nitrification and Denitrification – Removal of Phosphates –UASB–Membrane reactors-Integrated fixed film reactors. Anaerobic Processes: Septic Tanks and Imhoff tanks- working Principles and Design–Reuse and disposal of septic tank effluent, FAB Reactors.

**UNIT – VI: Bio-solids (Sludge) management:** Characteristics-SVI, handling and treatment of sludge-thickening – anaerobic digestion of sludge, Sludge Drying Beds. Centrifuge.  
**Disposal of sewage:** Methods of disposal – disposal into water bodies-Oxygen Sag Curve-Disposal into sea, disposal on land- sewage sickness.

### **Text Books**

1. Wastewater Engineering Treatment and Reuse, Metcalf & Eddy, Tata McGraw-Hill edition.
2. Industrial Water and Wastewater Management, K.V.S.G. Murali Krishna.
3. Elements of Environmental Engineering, K. N. Duggal, S. Chand & Company Ltd. New Delhi, 2012.

### **References**

1. Environmental Engineering, Howard S. Peavy, Donald R. Rowe, Teorge George Tchobanoglus – Mc-Graw-Hill Book Company, New Delhi, 1985
2. Wastewater Treatment for Pollution Control and Reuse, Soli. J Arceivala, Sham R Asolekar, Mc-GrawHill, NewDelhi; 3<sup>rd</sup> Edition
3. Environmental Engineering –II: Sewage disposal and Air Pollution Engineering, Garg, S. K., Khanna Publishers
4. Sewage treatment and disposal, P. N. Modi & Sethi.
5. Environmental Engineering, Ruth F. Weiner and Robin Matthews – 4th Edition Elsevier, 2003
6. Environmental Engineering, D. Srinivasan, PHI Learning Private Limited, New Delhi, 2011.