



# NANDHA ENGINEERING COLLEGE

(Autonomous)

Affiliated to Anna University Chennai ✦ Approved by AICTE ✦ Accredited by NAAC (A+ Grade)

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## 1.1.2 Details of Courses where Syllabus was carried out in

### B.E Civil Engineering (R17)

S.No	Course Code	Course Name	% of change
1.	17CEX27	Sustainable Construction and Lean Construction	100
2.	17CEX28	Energy Efficient Buildings	100
3.	17CEX29	Modern Construction Materials	100
4.	17CEX30	Advanced Construction Techniques	100
5.	17CEX31	Construction Equipment Management	100
6.	17CEX32	Resource Management in Construction	100
7.	17CEX33	Quality Control in Construction	100
8.	17CEX34	Intelligent building Techniques	100
9.	17CEX35	Earth and Rockfill	100
10.	17CEX36	Participatory Water Management	100
11.	17CEX37	Water Resources Systems Engineering	100
12.	17CEX38	Watershed Conservation Management	100
13.	17CEX39	Integrated Water Resources Management	100
14.	17CEX40	Urban Water Infrastructure	100
15.	17CEX41	Water Quality and Management	100
16.	17CEX42	Rainwater Harvesting	100
17.	17CEM01	Sustainable Infrastructure Development	100
18.	17CEM02	Green Technology	100
19.	17CEM03	Materials for Energy Sustainability	100
20.	17CEM04	Environment Ecology	100
21.	17CEM05	Environmental Health and Safety	100
22.	17CEM06	Introduction to Smart Cities	100
23.	17CEM07	Disaster Preparedness and Planning	100
24.	17CEM08	Energy Efficiency for Sustainable Development	100
Average			100%



  
**PRINCIPAL**  
Nandha Engineering College  
(Autonomous)  
Erode - 638 052,

**17CEX27- SUSTAINABLE CONSTRUCTION AND LEAN CONSTRUCTION**

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

**PREREQUISITE : NIL**

**COURSE OBJECTIVES AND OUTCOMES**

<b>Course Objectives</b>		<b>Course Outcomes</b> The students will be able to		<b>Related Program Outcomes</b>
<b>1.0</b>	To study about concepts of sustainable materials in construction	<b>1.1</b>	Describe the various sustainable materials used in construction.	e,g,i,l
<b>2.0</b>	To understand the energy calculations for construction materials	<b>2.1</b>	Explain the method of estimating the amount of energy required for building.	e,g,k
<b>3.0</b>	To impart knowledge in green buildings and environmental effects.	<b>3.1</b>	Describe the features of LEED, TERI and GRIHA ratings of buildings.	e,g,j,k,l
<b>4.0</b>	To understand the concepts of lean tools	<b>4.1</b>	Explain the core concepts of lean construction tools and techniques and their importance in achieving better productivity.	g,h,k
<b>5.0</b>	To impart knowledge on lean construction tools and techniques	<b>5.1</b>	Apply lean tools and techniques to achieve sustainability in construction projects.	e,g,k,l

**UNIT I - INTRODUCTION AND MATERIALS USED IN SUSTAINABLE CONSTRUCTION**

**(9)**

Introduction and definition of Sustainability - Carbon cycle - role of construction material: concrete and steel, etc. - CO2 contribution from cement and other construction materials - Recycled and manufactured aggregate - Role of QC and durability - Life cycle and sustainability.

**UNIT II - ENERGY CALCULATIONS**

**(9)**

Components of embodied energy - calculation of embodied energy for construction materials - Energy concept and primary energy - Embodied energy via-a-vis operational energy in conditioned building - Life Cycle energy use.

**UNIT III - GREEN BUILDINGS**

**(9)**

Control of energy use in building - National Building Code (NBC), ECBC code, codes in neighboring tropical countries - OTTV concepts and calculations - Features of LEED and TERI - Griha ratings - Role of insulation and thermal properties of construction materials - influence of moisture content and modeling -Performance ratings of green buildings - Zero energy building.

**UNIT IV - CORE CONCEPTS IN LEAN**

**(9)**

Introduction to the Course; Lean Overview; Need for Productivity Measurement and improvement; Productivity Measurement System (PMS).

**UNIT V - LEAN CONSTRUCTION TOOLS AND TECHNIQUES**

**(9)**

Sampling/ Work Sampling; Survey/ Foreman delay survey; Value Stream / Process Mapping - 5S , Collaborative Planning System (CPS)/ Last Planner™ System (LPS) - Big Room Approach, IT/BIM and Lean, How to Start Practicing Lean Tools in Project Site.

**TOTAL (L: 45) = 45 PERIODS**

**TEXT BOOKS:**

1. Charles J Kibert, "Sustainable Construction : Green Building Design and Delivery", 4<sup>th</sup> ed., Wiley Publishers 2016.
2. Ballard, G., Tommelein, I., Koskela, L. and Howell, G., "Lean Construction Tools and Techniques", 2002.

**REFERENCES:**

1. Steve Goodhew, "Sustainable Construction Process", Wiley Blackwell, UK, 2016.
2. Craig A. Langston & Grace K.C. Ding, "Sustainable Practices in the Built Environment", Butterworth Heinemann Publishers, 2011.
3. Salem, O., Solomon, J., Genaidy, A. and Luegring, M., "Site implementation and Assessment of Lean Construction Techniques", Lean Construction Journal, 2005.



**17CEX28 - ENERGY EFFICIENT BUILDINGS**

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

**PREREQUISITE : NIL****COURSE OBJECTIVES AND OUTCOMES**

<b>Course Objectives</b>		<b>Course Outcomes</b> The students will be able to		<b>Related Program Outcomes</b>
<b>1.0</b>	To create awareness of the necessity of energy needed for structures.	<b>1.1</b>	Explain the various energy consumptions pattern.	e,g
<b>2.0</b>	To study the different climate types and their influence in building design	<b>2.1</b>	Predict the climate change and environmental factors in building design.	e,f,g
<b>3.0</b>	To study about the Thermal performance in building design	<b>3.1</b>	Design buildings according to thermal environment.	e,f,i,k,l
<b>4.0</b>	To learn the energy consumptions in buildings	<b>4.1</b>	Identify the utilization of appliances and the principles behind them.	b,c,e
<b>5.0</b>	To understand the concept of energy audit and its applications	<b>5.1</b>	Apply the concept of energy audit in buildings.	f,g,h,k

**UNIT I - INTRODUCTION****(9)**

Need of Energy in buildings - assessment - Energy consumption pattern of various types of buildings - Factors influencing the energy use in building - Concepts of energy efficient building

**UNIT II - CLIMATE****(9)**

Study of climate types - their influence in building design - Environmental factors affecting building design - Analysis of thermal and visual environment. An overview of design concepts of energy efficient buildings for various zones - Cold and cloudy - Cold and sunny - Composite - Hot and dry - Moderate - Warm and humid.

**UNIT III - HEAT AND LIGHT****(9)**

Heat gain and loss phenomenon in buildings - Thermal performance parameters - Role of building enclosures, openings and materials in thermal environment - Basic principles of light and daylight - Energy efficient light design of buildings - Daylight design of buildings.

**UNIT IV - APPLIANCES IN BUILDINGS****(9)**

Major appliances in building and their energy consumptions - Principles of solar heating, cooling and power (PV) systems - Integration of energy efficient appliances with the buildings.

**UNIT V - ENERGY AUDIT****(9)**

Energy survey and energy audit of buildings - Calculation of energy inputs and utilization in buildings - Energy audit reports of buildings - Concepts of Green Buildings - energy rating of buildings.

**TOTAL (L: 45) = 45 PERIODS****TEXT BOOKS:**

1. LaJayamaha, "Energy - Efficient Building Systems: Green Strategies for Operation and Maintenance", Tata McGraw Hill, 2007.
2. Krishnan, A., Baker, N., Yannas, S. & Szokolay, S.V., "Climate Responsive Architecture - A Design Hand Book for Energy Efficient Buildings", Tata McGraw Hill Publishing Company Ltd, Delhi, 2001.

**REFERENCES:**

1. Chand, I. and Bhargava, P.K., "The Climatic Data Handbook", Tata McGraw Hill Publishing Company Limited, New Delhi 1999.
2. Threlkeld, J.L., "Thermal Environmental Engineering", Prentice-Hall, Englewood Cliffs, NJ, 1998.
3. Energy Conservation Building Code, CAU of Energy Efficiency, New Delhi, 2018.





**17CEX29 - MODERN CONSTRUCTION MATERIALS**

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

**PREREQUISITE : NIL****COURSE OBJECTIVES AND OUTCOMES**

<b>Course Objectives</b>		<b>Course Outcomes</b> The students will be able to		<b>Related Program Outcomes</b>
<b>1.0</b>	To impart knowledge on the properties of special concretes.	<b>1.1</b>	Use the special concrete based on the needs in the field.	f,g,l
<b>2.0</b>	To study the application of metals and its alloys.	<b>2.1</b>	Employ the correct metal as per prevailing weather conditions.	e,f
<b>3.0</b>	To impart knowledge on the various types of composites.	<b>3.1</b>	Select the appropriate composites for panel constructions.	g,i,k
<b>4.0</b>	To get knowledge on new construction materials for waterproofing and insulation.	<b>4.1</b>	Choose suitable waterproofing and insulating materials for effective construction.	c,g,l
<b>5.0</b>	To impart knowledge on smart and intelligent materials.	<b>5.1</b>	Utilize the state of art of energy efficient and self - healing materials	f,g,l

**UNIT I - SPECIAL CONCRETES****(9)**

Concrete and its behaviours - Properties, advantages and applications - High Strength Concrete - High Performance Concrete - Fiber Reinforced Concrete - Self-Compacting Concrete - Waste-material based concrete - Geopolymer concrete - Materials for fire, thermal, electrical and explosive resistance.

**UNIT II - METALS****(9)**

Types of Steel - Properties and manufacturing process - Advantages of new alloy steels - Properties and advantages of aluminium and its products - Types of coatings to reinforcement - Applications of coatings - Physical descriptions of asbestos sheets, GI sheets, tubes and light weight roofing materials.

**UNIT III - COMPOSITES****(9)**

Types of plastics - Properties and manufacturing process - Advantages of reinforced polymers - Types of FRP - FRP on different structural elements - Applications of FRP - Applications of metal, ceramics and polymer matrix composites.

**UNIT IV - SPECIAL MATERIALS****(9)**

.Types and properties of water proofing compounds - Properties of geo-synthetics and geo-membrane - Conventional and modern insulating materials - Thermal, sound and electrical insulating materials - Materials for 3D printing structures

**UNIT V - SMART AND INTELLIGENT MATERIALS****(9)**

Smart and intelligent materials - Special features and its types - Piezoelectric material and shape memory alloys - Energy harvesting material - Self healing polymer - Case studies on the applications of smart and intelligent materials - Sensor to detect structural cracks and health of structures.

**TOTAL (L: 45) = 45 PERIODS****TEXT BOOKS:**

1. Shetty M.S, "Concrete Technology: Theory and Practice", S. Chand & Company Ltd., 2016.
2. Shan Somayaji, "Civil Engineering Materials", Prentice Hall Inc., 2010.

**REFERENCES:**

1. ACI Report 440.2R-02, "Guide for the design and construction of Externally Bonded RP systems for Strengthening Concrete Structures", American Concrete Institute, 2012.
2. Ashby, M.F. and Jones.D.R.H.H. "Engineering Materials 1: An introduction to Properties, applications and designs", Elsevier Publications, 2015.
3. Mamlouk, M.S. and Zaniewski, J.P., "Materials for Civil and Construction Engineers", Prentice Hall Inc.,1999



**17CEX30 - ADVANCED CONSTRUCTION TECHNIQUES**

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

**PREREQUISITE : NIL****COURSE OBJECTIVES AND OUTCOMES**

<b>Course Objectives</b>		<b>Course Outcomes</b> The students will be able to		<b>Related Program Outcomes</b>
<b>1.0</b>	To impart knowledge on the substructure construction.	<b>1.1</b>	Identify the techniques for substructure Constructions.	j,l
<b>2.0</b>	To impart knowledge on the super structure construction.	<b>2.1</b>	Choose suitable technique for Super Structure Constructions	e,f,g,l
<b>3.0</b>	To impart knowledge on the special structure construction.	<b>3.1</b>	Handle the Special Structure Constructions like. Cooling towers, Offshore structure etc.	f,g,k,l
<b>4.0</b>	To underline and discuss about earthquake resistant buildings	<b>4.1</b>	Construct Earthquake Resistant Buildings	g,i,k,l
<b>5.0</b>	To provide understanding of modern construction techniques.	<b>5.1</b>	Select Modern Construction Techniques in construction projects.	e,f,g,l

**UNIT I - SUBSTRUCTURE CONSTRUCTION****(9)**

Box jacking- Pipe jacking - Diaphragm walls and basement - Tunneling Techniques - Piling Techniques - Driving well and caisson - Sinking cofferdam - Cable anchoring and grouting - Sheet piles - Offshore system - Shoring - Dewatering techniques.

**UNIT II - SUPER STRUCTURE CONSTRUCTION****(9)**

Vacuum dewatering - Concrete paving technology - Techniques for continuous concreting in tall buildings - Suspended formwork - Erection techniques of tall structures and large span structures - Launching techniques for heavy decks - In-situ pre-stressing in high rise structures, aerial transporting handling and erecting lightweight components on tall structures.

**UNIT III - SPECIAL STRUCTURE CONSTRUCTION****(9)**

Erection of lattice towers and transmission line structures - Cooling towers, silos, chimney, sky scrapers and cable stayed bridges - Launching of box decks - Offshore structures - Domes and pre - stress domes - Erection of articulated structures, braced domes and space decks - Spatial structures.

**UNIT IV - EARTHQUAKE RESISTANT BUILDINGS****(9)**

Planning of earthquake resistant buildings - Construction of walls - Provision of corner reinforcement - Construction of beams and columns - Base isolation

**UNIT V - MODERN CONSTRUCTION TECHNIQUES****(9)**

Precast Flat Panel System - 3D Volumetric Construction - 3D Printing - Hybrid Concrete Construction - Modular Construction Practices - Modular coordination and Standardization - Modular System Building - Limitation and Advantages

**TOTAL (L: 45) = 45 PERIODS****TEXT BOOKS:**

1. Jerry Irvine, "Advanced Construction Techniques", CA Rocketr, 2016.
2. Roger Greeno, Chudley R, Mike Hurst, Simon Topliss, "Advanced Construction Technology", 5<sup>th</sup> ed., 2012.



**REFERENCES:**

1. Allen E. Iano, J, "Fundamentals of Building Construction, Material and Method", John Wiley and Sons, 7<sup>th</sup> ed., 2019.
2. Cameron K. Andres, Ronald C. Smith, "Principles and Practices of Commercial Construction", 9<sup>th</sup> ed., Prentice Hall, 2018.
3. Sankar S.K. and Saraswati, S., "Construction Technology", Oxford University, New Delhi, 2018.



**17CEX31 - CONSTRUCTION EQUIPMENT MANAGEMENT**

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

**PREREQUISITE : NIL****COURSE OBJECTIVES AND OUTCOMES**

<b>Course Objectives</b>		<b>Course Outcomes</b>		<b>Related Program Outcomes</b>
		The students will be able to		
<b>1.0</b>	To impart knowledge on planning and managing the equipment as per the field requirement	<b>1.1</b>	Practise in analysing equipment characteristics and planning them effectively.	c,e,g
<b>2.0</b>	To understand equipment types and its operations	<b>2.1</b>	Select appropriate equipment with respect to construction works and ground conditions.	e,g,l
<b>3.0</b>	To impart knowledge on procurement of equipments	<b>3.1</b>	Explain about construction equipment procurement process.	e,g
<b>4.0</b>	To impart knowledge on the maintenance of equipment.	<b>4.1</b>	Employ and practice appropriate techniques for effective equipment maintenance.	d,e,f
<b>5.0</b>	To impart knowledge on the safety of equipment employed in different conditions.	<b>5.1</b>	Engage in suitable training and choose correct safety method while handling equipment.	e,h,k,l

**UNIT I - PLANNING AND MANAGEMENT OF EQUIPMENT****(9)**

Importance and role in construction field - Identification - Planning - Replacement - Cost control of equipment - Depreciation analysis - Replacement of equipment - Replacement analysis.

**UNIT II - EQUIPMENTS IN CONSTRUCTION****(9)**

Types of equipment and operations - Earth moving, pile driving, road construction, concrete placing, materials handling, off-site and on-site fabrication and repair works, mechanical and electrical equipment installation - Tunnelling - Techniques adopted - Performance characteristics related to the jobs in hand.

**UNIT III - EQUIPMENT PROCUREMENT MANAGEMENT****(9)**

Construction equipment - Purchase Order - Indents - Marketing - Registration of sellers - Selection and placement of Order - Follow up - Physical training - Physical Inspection and verification - fixation of the re-order level - Buying / Leasing / Hiring Option - Owner's tools and Plants

**UNIT IV - EQUIPMENT MAINTENANCE MANAGEMENT****(9)**

.Selection based on equipment performance - Equipment operations - Maintenance - Organize maintenance team - Training - Scheme for maintenance - Monitoring and effectiveness of management - Log book.

**UNIT V - EQUIPMENT SAFETY MANAGEMENT****(9)**

Training - Identification of needs - Training methods - Programmes, seminars, conferences and competitions - Safety training - Role of government agencies and private consulting agencies - Safe practice - Method of Promoting - Motivation, communication, creating awareness, awards, celebrations, safety posters, safety displays, safety pledge, safety incentive scheme and safety campaign - Domestic safety and training.

**TOTAL (L: 45) = 45 PERIODS****TEXT BOOKS:**

1. Sharma S.C., "Construction Equipment and Management", Khanna Publishers, New Delhi, 2017
2. Dr. Mahesh Varma, "Construction Equipment and its planning and Application", Metropolitan Book Company, New Delhi. 2010

#### REFERENCES:

1. Peurifoy, R.L., Ledbetter, W.B. and Schexnayder, C. "Construction Planning, Equipment and Methods", 6<sup>th</sup> ed., Tata McGraw-Hill, New Delhi, 2013
2. Dr.S. Seetharaman, "Construction Engineering and Management", Umesh Publications, 5<sup>th</sup> ed., 2015.
3. Deodhar, S.V., "Construction Equipment and Job Planning", Khanna Publishers, New Delhi, 2017
4. [https://basiccivilengineering.com/2015/04/type - of - equipment - use-in-construction.html](https://basiccivilengineering.com/2015/04/type-of-equipment-use-in-construction.html)

*P. V. Narayan Rao*

**17CEX32 - RESOURCE MANAGEMENT IN CONSTRUCTION**

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

**PREREQUISITE : NIL****COURSE OBJECTIVES AND OUTCOMES**

<b>Course Objectives</b>		<b>Course Outcomes</b> The students will be able to		<b>Related Program Outcomes</b>
<b>1.0</b>	To impart knowledge on the various functional areas of manpower.	<b>1.1</b>	Examine natured manpower in the construction field.	c,f,l
<b>2.0</b>	To impart knowledge on the classification, procurement, store management of materials.	<b>2.1</b>	Execute the management of construction materials effectively.	e,g,k
<b>3.0</b>	To expose the management of machinery used in field.	<b>3.1</b>	Select the equipment safely and maintaining the service records in a streamlined manner.	e,g,i,l
<b>4.0</b>	To provide the necessary knowledge on the various time management techniques.	<b>4.1</b>	Prepare the time phases of project and complete it within the stipulated time.	f,g,k,l
<b>5.0</b>	To impart knowledge on the types of cost and its management.	<b>5.1</b>	Discuss various costs involved in the project and carryout the time-cost trade off.	g,h,k

**UNIT I - MANPOWER MANAGEMENT****(9)**

Introduction - Organization - Fulcrum of the modern enterprise - Informal groups - Management - Employees - Human resource management

**UNIT II - MATERIAL MANAGEMENT****(9)**

Importance - Classification and Codification of materials - Inventory control - Managing the inventory and flow of raw materials, Work - in - Process, Finished Goods, and Supplies to ensure / enhance the organization's competitiveness and profitability - Stores Management - Quality control, Use of Material Management Systems (MMS).

**UNIT III - MACHINERY MANAGEMENT****(9)**

Identification - Planning - Equipment Management in Projects - Maintenance Managements - Replacement - Cost Control of equipment - Depreciation Analysis - Safety Management.

**UNIT IV - TIME MANAGEMENT****(9)**

Evolution of time management concepts - Need for time management - Challenges of project management (delays in pre-execution, construction phase) - Methods and processes for time management as per IS 15883-II, PMBOK - Work Breakdown Structure.

**UNIT V - COST MANAGEMENT****(9)**

Time Cost Analysis - Cost components of a construction project - Direct and indirect costs - Critical Chain Project Management - Delay Management - Earned Value Management (EVM) - Cost-Time Relationships - Utility Curves - S-Curves - Time-Cost trade-off.

**TOTAL (L: 45) = 45 PERIODS****TEXT BOOKS:**

1. A.K. Datta, "Materials Management: Procedures, Text and Cases", PHI Learning Pvt. Ltd., 2009.
2. Michael R. Canter, "Resource Management for Construction: An Integrated Approach", Macmillan, 3<sup>rd</sup> ed., 2005.

**REFERENCES:**

1. Glenn .A, Sears and Reichard, Clough .H, "Construction Project Management - A practical guide to field construction management", John Wiley and Sons, Inc, 2009
2. Richard J. Tersine, "Principles Of Inventory And Materials, Management", Prentice Hall,2004
3. P. Gopalakrishnan, Abid Haleem, "Handbook of Materials Management", PHI Learning Pvt. Ltd.2015



**17CEX33 - QUALITY CONTROL IN CONSTRUCTION**

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

**PREREQUISITE : NIL****COURSE OBJECTIVES AND OUTCOMES**

<b>Course Objectives</b>		<b>Course Outcomes</b> The students will be able to		<b>Related Program Outcomes</b>
<b>1.0</b>	To impart knowledge on the concepts of quality in construction site.	<b>1.1</b>	Interpret the quality check, audit and inspection	f,g,l
<b>2.0</b>	To provide the necessary knowledge about the quality improvement process.	<b>2.1</b>	Explain different quality improvement techniques.	e,f,g
<b>3.0</b>	To give an overview of the quality inspection program.	<b>3.1</b>	Execute quality inspection in the various construction works.	f,j,k,l
<b>4.0</b>	To introduce the concept of quality management system.	<b>4.1</b>	Adopt different quality management techniques, assurance and control techniques in construction industries.	f,i,l
<b>5.0</b>	To acquire knowledge on the quality management system and environment management system.	<b>5.1</b>	Employ ISO 9000 and ISO 14000 based on the functional nature of industries	c,e,f,h,l

**UNIT I - QUALITY****(9)**

Introduction - Quality Contributors at a Construction Site - Quality plan, quality audits, quality manual, PDCA cycle - Factors influencing construction quality - Quality plan - Inspection procedures - Total QA / QC programme.

**UNIT II - QUALITY IMPROVEMENT TECHNIQUES****(9)**

Excavation, Backfilling and Compaction - Tiling - Plastering - Waterproofing - Factors affecting Quality and Reliability - Quality control, tests and checklist - Quality in Execution - Good practices and Precautions - Remedial measures - Documentation

**UNIT III - QUALITY INSPECTION PROGRAM****(9)**

Concrete Mix Design - Concrete Quality - Formwork: Types, Quality control, checklist - pre, during and after, compliance - RCC Works: Coordinate checks, Pre and post pour checks - Defects in RCC Work, Precautions, Good practices, documentation - Brickwork and Blockwork Check for quality and compliance - Remedial measures, documentation - Inspection - Purpose - Reports and records

**UNIT IV - QUALITY MANAGEMENT****(9)**

.Objectives - Authority and responsibilities - Quality management guidelines - Quality councils and circles - Quality system documents - Quality related training - Implementing a quality system - Third party certification

**UNIT V - QUALITY STANDARDS****(9)**

Quality standards - Quality of cement, bricks, steel and concrete - Provisions of Indian standards - ISO 9000 and ISO 14000 standards.

**TOTAL (L: 45) = 45 PERIODS****TEXT BOOKS:**

1. Abdul Razzak Rumane, "Quality Management in Construction Projects", CRC Press, 2<sup>nd</sup> ed., 2018.
2. O'Brien, James J, "Construction Inspection Handbook - Total Quality Management", Springer, 3<sup>rd</sup> ed., 2012.



**REFERENCES:**

1. Hutchins.G, "ISO 9000 : A Comprehensive Guide to Registration, Audit Guideline and Successful Certification", Viva Books Pvt. Ltd.,
2. Juran Frank, J.M. and Gryna, F.M. "Quality Planning and Analysis: From Product Development through use", McGraw Hill, 6<sup>th</sup> ed., 2010.



**17CEX34 - INTELLIGENT BUILDING TECHNIQUES**

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

**PREREQUISITE : NIL****COURSE OBJECTIVES AND OUTCOMES**

<b>Course Objectives</b>		<b>Course Outcomes</b>		<b>Related Program Outcomes</b>
		The students will be able to		
<b>1.0</b>	To impart knowledge on the concepts of intelligent materials and buildings.	<b>1.1</b>	Analyse and fix the materials and technology involved in the intelligent buildings.	g,l
<b>2.0</b>	To study the functions of building comfort systems and its components	<b>2.1</b>	Choose the appropriate comfort systems and fabricate the HVAC system efficiently and effectively	e,f,i
<b>3.0</b>	To give an overview of the modern safety systems fitted in the building.	<b>3.1</b>	Execute ample safety measures that are required for the building in order to avert building accidents.	c,e,i
<b>4.0</b>	To understand the concepts of the electronics and communication systems involved in the modern buildings.	<b>4.1</b>	Select correct electronic components and construct a state of art built in electronic systems.	c,e,i
<b>5.0</b>	The factors which have influence on the performance of buildings	<b>5.1</b>	Improve the performance of buildings in terms of energy efficiency, clean environment and air pollution	c,e,g,l

**UNIT I - INTELLIGENT BUILDINGS****(9)**

Basic concepts - Intelligent building automation - Cost analysis - Smart materials and embedded sensor technology - Building management system and energy savings - Benefits.

**UNIT II - INTELLIGENT COMFORT SYSTEMS****(9)**

Basic HVAC system - Human comfort - Sensor - Occupancy sensors and temperature sensors - Energy efficient HVAC systems - Thermal energy storage - Under floor air distribution - Chilled beams - Other emerging HVAC technologies for high performance buildings - Automated car parking management.

**UNIT III - INTELLIGENT SAFETY SYSTEMS****(9)**

Life safety factors - Intrusion sensors - Space sensors - Closed circuit television and surveillance systems - Access control management system - Portrait id, swipe card access control, biometric access control - Fire protection systems - Smoke detection, automatic fire alarm detection, sprinklers, hose reels hydrants, foam systems - Microprocessor based alarm - Emergency control of elevator, doors, HVAC systems - Security and alarm system.

**UNIT IV - BUILDING ELECTRONICS****(9)**

.Microprocessor based control - Programmable logic controller - Communication principles - Telephone systems - Communal aerial broadcasting - Satellite communication - Fibre optic system.

**UNIT V - PERFORMANCE BUILDINGS****(9)**

High performance buildings - Control theory - Market trends - Energy efficiency - Environmental and greenhouse gas emission reduction - Clean development Mechanism - Practical benefits - Smart home - Smart office.

**TOTAL (L: 45) = 45 PERIODS****TEXT BOOKS:**

1. Shengwei Wang, "Intelligent Buildings and Building Automation", Spon Press, London, 2010.
2. Derek Clements Croome, "Intelligent Building: Design, Management and Operations", 3<sup>rd</sup> ed., Telford ICEP Publishers, London, 2014.



**17CEX35 - EARTH AND ROCK FILL DAMS**

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

**PREREQUISITE : NIL****COURSE OBJECTIVES AND OUTCOMES**

<b>Course Objectives</b>		<b>Course Outcomes</b> The students will be able to		<b>Related Program Outcomes</b>
<b>1.0</b>	To understand the factors influence design of rock fill dams	<b>1.1</b>	Assess the causes of failure and damage of embankments and slopes.	a,c,g,h,l
<b>2.0</b>	To learn reasons for failure and damages of embankments and slopes.	<b>2.1</b>	Analyse the stability of slopes for various seepage conditions and apply the concept in the design of earth and rock fill dams.	a,b,c,f,g,k
<b>3.0</b>	To impart knowledge on failure criteria for hydraulic fracturing	<b>3.1</b>	Apply the knowledge of engineering and assess the stability of dam against hydraulic fracturing and suggest suitable remedial measure.	a,c,l,k
<b>4.0</b>	To study damages of embankments and slopes, various methods of analysis of slopes and remedial techniques to protect the slopes.	<b>4.1</b>	Identify the nature of failures and damages in earth and rock fill dams and apply the concept in field to avoid distress.	a,b,c,g
<b>5.0</b>	To understand the remedial techniques to protect the slopes.	<b>5.1</b>	Recommend suitable remedial measures to protect the slopes and implement quality control and monitor its performance	a,d,g

**UNIT I - DESIGN CONSIDERATION****(9)**

Design consideration, Factors influencing design, Types of earth and rock fill dams, Design details, Provisions to control pore pressure.

**UNIT II - SLOPE STABILITY AND SEEPAGE ANALYSIS****(9)**

Stability of infinite and finite slopes, Method of Slices, Bishop's method, Flow nets, Stability conditions during construction, Full reservoir and drawdown - cut off walls - Trenches - Importance of drainage and filters.

**UNIT III - HYDRAULIC FRACTURING****(9)**

Introduction, Conditions and mechanisms for hydraulic fracturing, Failure criterion for hydraulic fracturing - cubic specimen with a crack - core with a transverse crack - core with a vertical crack, strike - dip of easiest crack spreading; factors affecting hydraulic fracturing, self - healing of a core crack.

**UNIT IV - FAILURE AND DAMAGES****(9)**

Failure and damages, Nature and importance of failures in embankment and foundation - Piping, Differential settlement, Foundation slides, Earthquake damage, creep and anisotropic effects, Reservoir wave action, Dispersive piping.

**UNIT V - SLOPE PROTECTION MEASURES****(9)**

Special design problems, Slope protection, Filter design, Foundation treatment, Earth dams on pervious soil foundation, Application of geosynthetic materials in filtration. Treatment of rock foundation, Construction Techniques, Quality control and performance measurement.

**TOTAL (L: 45) = 45 PERIODS****TEXT BOOKS:**

1. Rowe, R.K., "Geotechnical and Geoenvironmental Engineering Handbook", Kulwer Academic Publishers, 2001.
2. Anderson, M.G., and Richards, K.S., "Slope Stability", John Wiley, 1987.

3. McCarthy, D.F., "Essentials of Soil Mechanics and Foundations: Basic Geotechnics", 16<sup>th</sup> ed., Prentice Hall, 2002.

**REFERENCES:**

1. Bramhead, E.N., "The Stability of Slopes", Blacky Academic and Professionals Publications, Glasgow, 1986.
2. Chandhar, R.J., "Engineering Developments and Applications", Thomas Telford, 1991
3. Koerner, R.M. "Designing with Geosynthetics", 3<sup>rd</sup> ed., Prentice Hall, 1997.
4. Jun-Jie Wang, "Hydraulic Fracturing in Earth-rock Fill Dams", John Wiley & Sons, 2014 Sherard, J.L.,
5. Woodward, R.J., Gizienski, R.J. and Clevenger, W.A., "Earth and Earth Rock Dam", John Wiley, 1963.

*Dr. A. M. M. M. M. M.*

**17CEX36 - PARTICIPATORY WATER RESOURCES MANAGEMENT**

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

**PREREQUISITE : NIL**

**COURSE OBJECTIVES AND OUTCOMES**

<b>Course Objectives</b>		<b>Course Outcomes</b> The students will be able to		<b>Related Program Outcomes</b>
<b>1.0</b>	To understand the regional and global experiences of participatory ideology in irrigation water management	<b>1.1</b>	Capture to fundamental concepts and terms which are to be applied and understood all through the study	f,g
<b>2.0</b>	To acquire knowledge on paradigms shifts and reorientations with regard to stakeholder participation in water management in general and in irrigation management in particular.	<b>2.1</b>	State a clear insight of participatory ideology with its rudiments under the light of both national and international illustrative cases.	c,g
<b>3.0</b>	To get idea on the importance of water resource management	<b>3.1</b>	Comprehend the roles of different players as stakeholders with the ground reality of the underlying issues in farm community.	c,f,j,i
<b>4.0</b>	To identify the components of water storage structures along with its functions	<b>4.1</b>	Express how reforms can help build up institutional and irrigation agencies with the support obtained from the existing farm network in irrigation Management	f,j,l,k
<b>5.0</b>	To impart knowledge on policies for emerging challenges	<b>5.1</b>	Recommend irrigation management with a vision to transform the existing governance and policies with the novel approach of sustainability.	f,g

**UNIT I - FUNDAMENTALS OF SOCIOLOGY AND PARTICIPATORY APPROACH**

**(6)**

Basic Sociological concepts and Definitions - Objectives - Perspectives - Social stratification - Sociological understanding - Irrigation as a Sociotechnical Process - paradigm shift and Participatory approach

**UNIT II - UNDERSTANDING FARMERS PARTICIPATION**

**(12)**

Need of farmers participation –Benefits of farmers participation - Comparisons of cost and benefit Water User Association - Membership - Kinds of participation - National and International Experiences - Activities on Water towards Organization and Structure - Context of participation-factors in the environment.

**UNIT III - ROLE OF STAKEHOLDERS AND THE UNDERLYING ISSUES**

**(12)**

Multiple use of water - Issues in sectoral water allocation - Domestic, Irrigation, Industrial sectors - Woman as a water user - Constraints and Opportunities. Role of community organisers - Constraints in organising farmers organisation.

**UNIT IV - IMPROVING AGENCY RELATIONS AND INSTITUTIONAL REFORMS**

**(10)**

Supporting farmer organization and participation - Decision Making - Leadership and responsibilities - Development strategy - Channels for implementation - Equity and Equality - Agency Incentives - Technical co-operation - Special roles - Agency Roles - Institutional Reforms

**UNIT V - POLICY CONSIDERATIONS AND EMERGING CHALLENGES**

**(5)**

Water Policy - Irrigation Governance - Building from Below - Non-political Associations - Bureaucratic Reorientation - Policy options and Alternatives and Sustainability.

**TOTAL (L: 45) = 45 PERIODS**



**TEXT BOOKS:**

1. Sivasubramaniam K., "Water Management", SIMRES Publication, Chennai 2009
2. Michael C.M., Putting people first, "Sociology variables in Rural Development", Oxford University press, London 1985.

**REFERENCES:**

1. Desai A.R., "Rural sociology in India", Popular Prakashan, Bombay, 1969.
2. Uphoff. N., "Improving International Irrigation management with Farmer Participation - Getting the process Right - Studies in water Policy and management", New West - View press, Boulder and London, 1986.
3. <http://irapindia.org/IMTInIndia-Pa>
4. <http://mowr.gov.in/writereaddata/mainlinkFile/File421.pdf>



17CEX37 - WATER RESOURCES SYSTEMS ENGINEERING					
		L	T	P	C
		3	0	0	3
PREREQUISITE : NIL					
<b>COURSE OBJECTIVES AND OUTCOMES</b>					
Course Objectives		Course Outcomes The students will be able to			Related Program Outcomes
1.0	To introduce the student to the concept of Mathematical approaches for managing the water resources system and apply to operate a water resource system optimally.	1.1	Define the economic aspects and analysis of water resources systems for comprehensive and integrated planning of a water resources project.	d,f,g	
2.0	To gain a better understanding of the complex interactions among all the hydrologic, ecologic, economic, engineering and social components of water resource systems, analyses based on systems perspectives	2.1	Apply the concept of linear programming for optimisation of water resources problems.	b,d,e,f	
3.0	To introduce the science and art of developing and applying various modeling approaches in support of water resources planning and management	3.1	Explain the concept of dynamic programming and apply in water resource system.	e,f,g,i	
4.0	To emphasize the practice of developing and using models to address specific water resources planning and management issues and problems.	4.1	Develop the simulation model based on deterministic and stochastic simulation for reservoir operating policy	c,e,g	
5.0	To provide relevant, objective, timely and meaningful information to those who are responsible for deciding how we develop, manage, and use our water resources.	5.1	Apply advance optimisation techniques like goal programming, heuristic algorithm in the field of water resources planning and management	b,c,e	

<b>UNIT I - SYSTEM APPROACH</b>	<b>(9)</b>
Definition, classification, and characteristics of systems - Philosophy of modelling - Goals and Objectives - Basics of system analysis concept - steps in systems engineering.	
<b>UNIT II - LINEAR PROGRAMMING</b>	<b>(9)</b>
Introduction to Operation research - Linear programming Problem Formulation - graphical solution Simplex method - Sensitivity analysis - application to operation of single purpose reservoir	
<b>UNIT III - DYNAMICPROGRAMMING</b>	<b>(9)</b>
Bellman's optimality criteria, problem formulation and solutions - Water Allocation for three state (user), Forward and Backward Recursion techniques in Dynamic Programming - Shortest pipe line route problem - Application to reservoirs capacity expansion	
<b>UNIT IV - SIMULATION</b>	<b>(9)</b>
Basic principles and concepts - Monte Carlo techniques - Model development - Inputs and outputs - Single and multipurpose reservoir simulation models - Deterministic simulation - Rule Curve development for reservoir	
<b>UNIT V - ADVANCEDOPTIMIZATIONTECHNIQUES</b>	<b>(9)</b>
Integer and parametric linear programming - Goal programming types - Applications to reservoir release optimization - application of evolutionary algorithms like Genetic algorithm, Particle swarm, Simulated Annealing to reservoir release optimization	
<b>TOTAL (L: 45) = 45 PERIODS</b>	

**TEXT BOOKS:**

1. Vedula, S., and Majumdar, P.P. "Water Resources Systems - Modeling Techniques and Analysis", Tata McGraw Hill, New Delhi, Fifth reprint, 2010.
2. Bhave PR, "Water Resources Systems", Narosa Publishers, 2011

**REFERENCES:**

1. Gupta, P.K., and Man Mohan, "Problems in Operations Research (Methods and Solutions)", Sultan Chand and Sons, New Delhi, 1995.
2. Chaturvedi, M.C., "Water Resources Systems Planning and Management", Tata McGraw Hill, New Delhi, 1997.
3. Taha, H.A., "Operations Research", McMillan Publication Co., New York, 1995.



**17CEX38 - WATERSHED CONSERVATION AND MANAGEMENT**

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

**PREREQUISITE : NIL****COURSE OBJECTIVES AND OUTCOMES**

<b>Course Objectives</b>		<b>Course Outcomes</b> The students will be able to		<b>Related Program Outcomes</b>
<b>1.0</b>	To make the student understand the watershed based water resources development and implementation of conservation practices	<b>1.1</b>	Recognize and Interpret the morphological features of a watershed	c,g,
<b>2.0</b>	To provide the technical and sociological understanding of a watershed.	<b>2.1</b>	State, design and sketch the soil conservation structures.	a,c,g,k
<b>3.0</b>	To provide a comprehensive discourse on the engineering practices of watershed management for realizing the higher benefits.	<b>3.1</b>	Describe the micro catchment and apply the concepts to design the small water harvesting structures.	b,c,g,h
<b>4.0</b>	To Implant the sustainable management of natural resources of the watershed	<b>4.1</b>	Illustrate the application of modern tools and technology in the management of watershed	e,g,j
<b>5.0</b>	To access better watershed management plan for applications of Remote Sensing and GIS	<b>5.1</b>	Classify the management activities and to develop an integrated watershed development plan.	g,i,k

**UNIT I - WATERSHED CONCEPTS****(9)**

Watershed - Definition, Need and Elements - Principles - Influencing Factors: Geology - Soil - Morphological Characteristics - Toposheet - Delineation - Codification - Prioritization - Watershed Atlas.

**UNIT II - SOIL CONSERVATION MEASURES****(9)**

Types of Erosion - Water and Wind Erosion: Causes, Factors, Effects and Management - Soil Conservation Measures: Agronomical and Mechanical - Design of Terraces and Bunds - Estimation of Soil Loss - USLE Equation - Sedimentation.

**UNIT III - WATER HARVESTING AND CONSERVATION****(9)**

Yield from a Catchment - Traditional Water Harvesting Techniques - Micro - Catchments - Design of Small Water Harvesting Structures: Farm Ponds, Percolation Tanks, Check dams, Grassed Waterways.

**UNIT IV - GIS FOR WATERSHED MANAGEMENT****(9)**

Applications of Remote Sensing and Geographical Information System - Role of Decision Support System - Conceptual Models and Case Studies.

**UNIT V - WATERSHED MANAGEMENT****(9)**

Project Proposal Formulation - Watershed Development Plan - Entry Point Activities - Watershed Economics - Agroforestry - Grassland Management - Wasteland Management - Watershed Approach in Government Programmes - People's Participation - Evaluation of Watershed Management Programmes - Integrated Watershed Management - Case studies

**TOTAL (L: 45) = 45 PERIODS****TEXT BOOKS:**

1. Ghanashyam Das, "Hydrology and Soil Conservation Engineering", Prentice Hall of India Private Limited, New Delhi, Second Edition, 2009.
2. Suresh, R. "Soil and Water Conservation Engineering", Standard Publishers and Distributors Private Limited, New Delhi, 2020.

**REFERENCES:**

1. Glenn O Schwab, "Soil and Water Conservation Engineering", Wiley India Private Limited, 2009.
2. Heathcote, I. W. "Integrated Watershed Management: Principles and Practice", John Wiley and Sons, Inc., New York, 2<sup>nd</sup> ed., 2009.
3. John G. Lyon, "GIS for Water Resources and Watershed Management", CRC Press, 2002.
4. Vijay P. Singh, Donald K. Frevert, "Watershed Models", CRC Press, 2005.



**17CEX39 - INTEGRATED WATER RESOURCES MANAGEMENT**

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

**PREREQUISITE: NIL**

**COURSE OBJECTIVES AND OUTCOMES**

<b>Course Objectives</b>		<b>Course Outcomes The students will be able to</b>		<b>Related Program Outcomes</b>
<b>1.0</b>	To introduce the concepts and principles of IWRM.	<b>1.1</b>	Describe the context and principles of IWRM; Compare the conventional and integrated ways of water management.	<b>d,g</b>
<b>2.0</b>	To gain knowledge on role of disciplines of ecology and socio-economic play in management of water resources.	<b>2.1</b>	Select the best economic option among the alternatives; illustrate the pros and cons of PPP through case studies.	<b>c,f,k</b>
<b>3.0</b>	To expose to global food security and public-private participation issues and legal and regulatory settings, in the context of IWRM	<b>3.1</b>	Apply law and governance in the context of IWRM	<b>c,f,g</b>
<b>4.0</b>	To introduce the economics, public-private partnership.	<b>4.1</b>	Discuss the linkages between water-health; develop a HIA framework	<b>c,f,g</b>
<b>5.0</b>	To understand water & health, water & food security and legal & regulatory settings.	<b>5.1</b>	Analyse how the virtual water concept pave way to alternate policy options	<b>f,i,k</b>

**UNIT I - CONTEXT FOR IWRM**

**(9)**

Water as a global issue: Key challenges - Definition of IWRM within the broader context of development - Key elements of IWRM - Principles - Paradigm shift in water management - Complexity of the IWRM process - UN World Water Assessment - SDGs

**UNIT II - WATER ECONOMICS**

**(9)**

Economic view of water issues: Economic characteristics of water good and services - Non-market monetary valuation - Water economic instruments - Private sector involvement in water resources management: PPP objectives, PPP models, PPP processes, PPP experiences through case studies.

**UNIT III - LEGAL AND REGULATORY SETTINGS**

**(9)**

Basic notion of law and governance: Principles of International and National law in the area of water management - Understanding UN law on non-navigable uses of International water courses - International law for groundwater management - World Water Forums - Global Water Partnerships - Development of IWRM in line with legal and regulatory framework: Case Studies.

**UNIT IV - WATER AND HEALTH WITHIN THE IWRM CONTEXT**

**(9)**

Links between water and health: Options to include water management interventions for health - Health protection and promotion in the context of IWRM - Global burden of Diseases - Health impact assessment of water resources development projects - Case studies.

**UNIT V - AGRICULTURE IN THE CONCEPT OF IWRM**

**(9)**

Water for food production: 'blue' versus 'green' water debate - Water foot print - Virtual water trade for achieving global water and food security - Climate Smart Agriculture - Current water pricing policy - Scope to relook pricing.

**TOTAL (L: 45) = 45 PERIODS**

**TEXT BOOKS:**

- Cech Thomas V., "Principles of water resources: history, development, management and policy", John Wiley and Sons Inc., New York. Fourth Edition 2018.
- Mollinga.P, "Integrated Water Resources Management", Water in South Asia Volume I, Sage Publications, 2006.



## REFERENCES:

1. Technical Advisory Committee, "Integrated Water Resources management", Technical Advisory Committee Background Paper No: 4. Global water partnership, Stockholm, Sweden. 2002.
2. Technical Advisory Committee, "Effective Water Governance", Technical Advisory Committee Background Paper No: 7. Global water partnership, Stockholm, Sweden, 2003.
3. Tony Allan, Virtual Water : Tackling the Threat to Our Planet's Most Precious Resource, I. B. Taurus, 2011.

*P. A. M. P. S. S. S.*

**17CEX40 - URBAN WATER INFRASTRUCTURE**

L	T	P	C
3	0	0	3

**PREREQUISITE: NIL****COURSE OBJECTIVES AND OUTCOMES**

Course Objectives		Course Outcomes The students will be able to		Related Program Outcomes
1.0	To impart knowledge and skills relevant to water management in the context of urbanization.	1.1	Explain various functional elements of urban ecosystem	f,g
2.0	To introduce the concepts of water management in the context of urbanization and relate engineering principles to water supply, storm water and wastewater management.	2.1	Calculate urban runoff, compute supply and demand of water, draw hydrograph	f,g
3.0	To introduce to the concepts of urbanization and its impact on the natural water cycle.	3.1	Compare advantages of Newer techniques of green infrastructure and illustrate benefits	d,g
4.0	To prepare Master plans for urban water management.	4.1	Assess the Operation and Maintenance needs of urban water systems	d,g,i
5.0	To introduce the concepts of regulations and best management practices from around the world.	5.1	Propose best management practices for Indian context	f,i,k

**UNIT I - URBAN ECOSYSTEM****(9)**

Cities as Ecological system - hybrid ecosystem - Resilience in urban ecosystem. Human components of Ecosystem - Urban pattern and Ecosystem function. Population and Community dynamics, functions of Urban Ecosystem.

**UNIT II - URBAN HYDROLOGY****(9)**

The urban hydrological cycle - Function - Human induced changes in urban watershed - Hydrological calculation - Runoff - Infiltration - hydrograph.

**UNIT III - URBAN STORM WATER MANAGEMENT****(9)**

Design of Drainage System - Roadway Drainage Analysis - Types of inlet - Inlet design - Design of storm drain - Storm water management regulations - Structural Storm Management systems - Newer trends in storm water management (Green infrastructure) - Installation - Operation and maintenance.

**UNIT IV - WATER CONSERVATION AND REUSE****(9)**

Trends in supply and demand - Indoor conservation - Outdoor conservation - Water reuse - Rainwater harvesting - public education

**UNIT V - WATER GOVERNANCE****(9)**

Challenges in water sector - Institutional setting, Supply Management, Demand Management, Waste water management - Private sector participation, urban service delivery, customer satisfaction, financial resource management – case studies of best practices in cities across the world.

**TOTAL (L: 45) = 45 PERIODS****TEXT BOOKS:**

1. Anand Chiplunkar, K Seetharam and Cheon Kheong (ed)), "Good Practices in urban water management" ADB, National University Singapore, 2012
2. Marina Alberti (2008), "Advances in Urban Ecology", Springer R
3. Mohammad Karamouz, Ali Moridi, Sara Nazif , , "Urban Water Engineering and Management", 1<sup>st</sup> ed., CRC Press ,2010

**REFERENCES:**

1. HormozPazwash (2016), "Urban storm water management", CRC Press
2. Larry W. Mays, (2004), Urban Stormwater Management Tools, McGraw-Hill Companies

**17CEX41- WATER QUALITY AND MANAGEMENT**

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

**PREREQUISITE: NIL****COURSE OBJECTIVES AND OUTCOMES**

<b>Course Objectives</b>		<b>Course Outcomes The students will be able to</b>		<b>Related Program Outcomes</b>
<b>1.0</b>	To understand the fundamentals of mathematical models and their importance in water quality modeling.	<b>1.1</b>	Identify the principles of water quality modelling.	<b>b,g</b>
<b>2.0</b>	To impart the skills to use water quality modelling software for surface and groundwater quality modelling.	<b>2.1</b>	Choose the pollutant transport phenomena in surface and groundwater.	<b>f,g</b>
<b>3.0</b>	To introduce water quality concepts, its evaluation	<b>3.1</b>	Apply the knowledge of surface water quality modelling to predict the water quality of rivers, lakes and estuary.	<b>c,f</b>
<b>4.0</b>	To understand the importance of water quality and Management and major uses of water and the role environmental issues.	<b>4.1</b>	Predict the groundwater contamination transport.	<b>d,e,g</b>
<b>5.0</b>	To study about transportation of pollution contaminants	<b>5.1</b>	Predict water quality of surface and sub surface water using numerical solution	<b>c,e,g,i</b>

**UNIT I - MODELLING INSIGHTS****(9)**

Engineers and Mathematical models - Water quality models - historical development - different types of models - steps in model development - importance of model building - calibration and verification of models - finite element, finite difference and finite volume methods

**UNIT II - POLLUTION TRANSPORT****(9)**

Transport phenomena - advection, diffusion, dispersion - contamination transport in surface and subsurface water - Simple transport models - steady state and time variable solutions - conservation of mass, momentum and energy balance, governing equation for contaminant fate and transport

**UNIT III - SURFACE WATER QUALITY MODELLING****(9)**

Water quality modeling of streams, lakes and estuaries - water quality- model sensitivity - assessing model performance; Models for dissolved oxygen, pathogens and COD, BOD - Streeter Phelp's model for point and distributed sources - modified streeter Phelp's equations.

**UNIT IV - GROUNDWATER QUALITY MODELLING****(9)**

Groundwater flow and mass transport of solutes - groundwater quality modelling using numerical methods - Parameters, Input - output stresses, Initial and Boundary conditions - degradation of organic compounds in subsurface - Model calibration : steady state and unsteady state - sensitivity analysis – Model validation - seawater intrusion - basic concepts and modelling.

**UNIT V - WATER QUALITY MANAGEMENT MODELS****(9)**

Exposure to surface water and groundwater quality modelling software's - MIKE 21, WASP, QUAL2E and MODFLOW - demonstration - case studies - Modeling multilayer groundwater flow system - Artificial recharge feasibility through modeling - Groundwater contamination, restoration and management.

**TOTAL (L: 45) = 45 PERIODS****TEXT BOOKS:**

1. Steven C. Chapra, "Surface Water Quality Modelling", Tata McGraw-Hill Companies, Inc., New Delhi 2018.
2. Benedini, Marcello, Tsakiris, George, "Water Quality Modelling for Rivers and Streams", Springer Netherlands, 2017.

**REFERENCES:**

1. Jacob Bear, A. H.-D. Cheng, "Modelling Groundwater Flow and Contaminant Transport", Springer Science & Business Media, 2010.
2. Ne-Zheng Sun, Alexander Sun "Mathematical Modelling of Groundwater Pollution", Springer New York, 2012

*Jacob Bear*

**17CEX42 - RAIN WATER HARVESTING**

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

**PREREQUISITE: NIL****COURSE OBJECTIVES AND OUTCOMES**

<b>Course Objectives</b>		<b>Course Outcomes The students will be able to</b>		<b>Related Program Outcomes</b>
<b>1.0</b>	To impart knowledge and skills relevant to water conservation and management towards achieving the sustainability in water resources	<b>1.1</b>	Interpret the need and importance of water conservation through global and Indian practices of rainwater harvesting	<b>e,g</b>
<b>2.0</b>	To relate the engineering principles and practices in estimation of runoff, storage, recharge into the ground	<b>2.1</b>	Apply the concepts of hydrology and groundwater in the estimation of runoff and recharge potentials	<b>b,k</b>
<b>3.0</b>	To understand the methods of rain water harvesting.	<b>3.1</b>	Identify the various types of rainwater harvesting methods and apply it on the field	<b>e,g,i,l</b>
<b>4.0</b>	To study the concepts of rain water harvesting structures.	<b>4.1</b>	Design the various RWH structures to harvest the rainwater in surface and subsurface	<b>c,e,i,j</b>
<b>5.0</b>	To understand the maintain the system through the best management practices followed around the world.	<b>5.1</b>	Explain the difficulties of RWH, evaluation methods and maintenance through various case studies.	<b>c,f,l,k</b>

**UNIT I - BASICS OF RWH****(9)**

Water and its sources - Need for water conservation - Types of water demand - Conservation Methods - Global and Indian perspectives - National mission and goals towards rainwater harvesting - National water policy - Legislation on rainwater harvesting in India and Tamil Nadu.

**UNIT II - HYDROLOGY AND GROUND WATER****(9)**

Hydrological cycle - Precipitation - Rainfall measurement - Rain-gauges - Hyetograph - Infiltration - Runoff estimation - Rooftop runoff estimation. Ground water - Aquifer Properties - Darcy law and well hydraulics - Steady flow.

**UNIT III - METHODS OF RAINWATER HARVESTING****(9)**

Rainwater harvesting potential of an area - Traditional harvesting practices - Rooftop harvesting - Methods of RWH structures - Site selection for rainwater harvesting - Surface runoff Harvesting - Ground water recharge - Artificial recharge.

**UNIT IV - DESIGN OF RAINWATER HARVESTING STRUCTURES****(9)**

Design Considerations - Components of Rainwater harvesting system - Simple roof water collection system - Design of Storage structure - Design of Recharge structures - Recharge pit - Recharge trench - Recharge well - Gully plug - Contour bund - Percolation tank - Check dam - Recharge shaft - Efficiency of RWH system

**UNIT V - MANAGEMENT OF RWH AND CASE STUDIES****(9)**

Difficulties in RWH - At catchment level - At household level - Evaluation of RWH systems - Maintenance of RWH structures - Modernisation of RWH system - Case studies on best practice of RWH in urban - Success stories of Contemporary practices of RWH in India.

**TOTAL (L: 45) = 45 PERIODS**

**TEXT BOOKS:**

1. H.M Raghunath "Ground Water" 3<sup>rd</sup> ed., New Age International 2007.
2. Jayarami Reddy.P, "A Text book of Hydrology", Firewall media Publication, 2005
3. Ramakrishnan S, "Ground Water", Scitech Publications (India) Pvt Ltd, 2010

**REFERENCES:**

1. Rainwater Harvesting: Indian Railway Institute of Civil Engineering Pune, October 2015.
2. A Manual on "Rainwater Harvesting and Conservation": Government of India, Consultancy Service Organization Central Public Works Department, New Delhi.
3. "A Water Harvesting Manual for Urban Areas" , Centre for Science and Environment.
4. Traditional Water Harvesting Systems of India, C.P.R. Environmental Education Centre, Chennai, India (2004).



**17CEM01 - SUSTAINABLE INFRASTRUCTURE DEVELOPMENT**

L	T	P	C
3	0	0	3

**PREREQUISITE : NIL**

**COURSE OBJECTIVES AND OUTCOMES**

Course Objectives		Course Outcomes The students will be able to		Related Program Outcomes
1.0	To impart knowledge about sustainable Infrastructure development goals, practices.	1.1	Relate the environment sustainability goals at global and Indian scenario	f,g,j
2.0	To understand the concepts of sustainable planning and design.	2.1	Assess the risks in development of projects and suggest mitigation measures.	c,f,k
3.0	To understand the concepts of construction, maintenance.	3.1	Apply lean techniques, LBMS and new construction techniques to achieve sustainability in infrastructure construction projects	c,f,i
4.0	To impart knowledge about sustainable materials for construction	4.1	Explain Life Cycle Analysis and life cycle cost of construction materials.	c,f,h
5.0	To understand the concepts of decommissioning of infrastructure projects.	5.1	Apply the new technologies for maintenance of infrastructure projects.	e,f,l

**UNIT I - SUSTAINABLE DEVELOPMENT GOALS**

**(9)**

Definitions, principles and history of Sustainable Development - Sustainable development goals (SDG): global and Indian - Infrastructure Demand and Supply - Environment and Development linkages - societal and cultural demands - Sustainability indicators - Performance indicators of sustainability and Assessment mechanism - Policy frameworks and practices: global and Indian - Infrastructure Project finance - Infrastructure project life cycle - Constraints and barriers for sustainable development - future directions.

**UNIT II - SUSTAINABLE INFRASTRUCTURE PLANNING**

**(9)**

Overview of Infrastructure projects: Housing sector, Power sector, Water supply, road, rail and port transportation sector, rural and urban infrastructure. Environmental Impact Assessment (EIA), Land acquisition - Legal aspects, Resettlement & Rehabilitation and Development - Cost effectiveness Analysis - Risk Management Framework for Infrastructure Projects, Economic, demand, political, socio-environmental and cultural risks. Shaping the Planning Phase of Infrastructure Projects to mitigate risks, Designing Sustainable Contracts, Negotiating with multiple Stakeholders on Infrastructure Projects. Use of ICT tools in planning - Integrated planning - Clash detection in construction - BIM (Building Information Modelling).

**UNIT III - SUSTAINABLE CONSTRUCTION PRACTICES AND TECHNIQUES**

**(9)**

Sustainability through lean construction approach - Enabling lean through information technology - Lean in planning and design - IPD (Integrated Project Delivery) - Location Based Management System - Geospatial Technologies for machine control, site management, precision control and real time progress monitoring - Role of logistics in achieving sustainable construction - Data management for integrated supply chains in construction - Resource efficiency benefits of effective logistics - Sustainability in geotechnical practice - Design considerations, Design Parameters and Procedures - Quality control and Assurance - Use of sustainable construction techniques: Precast concrete technology, Pre-engineered buildings

**UNIT IV - SUSTAINABLE CONSTRUCTION MATERIALS****(9)**

Construction materials: Concrete, steel, glass, aluminium, timber and FRP - No/Low cement concrete - Recycled and manufactured aggregate - Role of QC and durability - Sustainable consumption - Eco-efficiency - green consumerism - product stewardship and green engineering - Extended producer responsibility - Design for Environment Strategies, Practices, Guidelines, Methods, And Tools. Eco-design strategies -Design for Disassembly - Dematerialization, rematerialization, transmaterialization - Green procurement and green distribution - Analysis framework for reuse and recycling - Typical constraints on reuse and recycling - Communication of Life Cycle Information - Indian Eco mark scheme - Environmental product declarations - Environmental marketing- Life cycle Analysis (LCA), Advances in LCA: Hybrid LCA, Thermodynamic LCA - Extending LCA - economic dimension, social dimension - Life cycle costing (LCC) - Combining LCA and LCC - Case studies

**UNIT V - SUSTAINABLE MAINTENANCE OF INFRASTRUCTURE PROJECTS****(9)**

Case Studies - Sustainable projects in developed countries and developing nations - An Integrated Framework for Successful Infrastructure Planning and Management - Information Technology and Systems for Successful Infrastructure Management, - Structural Health Monitoring for Infrastructure projects - Innovative Design and Maintenance of Infrastructure Facilities - Capacity Building and Improving the Governments Role in Infrastructure Implementation, Infrastructure Management Systems and Future Directions - Use of Emerging Technologies - IoT, Big Data Analytics and Cloud Computing, Artificial Intelligences, Machine and Deep Learning, Fifth Generation (5G) Network services for maintenance .

**TOTAL (L: 45) = 45 PERIODS****TEXT BOOKS:**

1. Charles J Kibert, "Sustainable Construction: Green Building Design & Delivery", 4<sup>th</sup> ed., Wiley Publishers 2016.
2. Steve Goodhew, "Sustainable Construction Process", Wiley Blackwell, UK, 2016.
3. Kerry Turner. R, "Sustainable Environmental Management", Principles and Practice Publisher : Belhaven Press,ISBN:1852930039.

**REFERENCES:**

1. Craig A. Langston & Grace K.C. Ding, "Sustainable Practices in the Built Environment", Butterworth Heinemann Publishers, 2011.
2. William P Spence, "Construction Materials, Methods & Techniques (3e)", Yesdee Publication Pvt. Ltd, 2016.



**17CEM02 - GREEN TECHNOLOGY**

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

**PREREQUISITE : NIL****COURSE OBJECTIVES AND OUTCOMES**

<b>Course Objectives</b>		<b>Course Outcomes</b> The students will be able to		<b>Related Program Outcomes</b>
<b>1.0</b>	To impart knowledge on the principles of green chemistry	<b>1.1</b>	Identify the principles of green engineering and technology	<b>g,i,k,l</b>
<b>2.0</b>	To provide green engineering solutions to energy demand, reduced energy footprint	<b>2.1</b>	Explain about pollution using hazardous chemicals and solvents	<b>f,g,j</b>
<b>3.0</b>	To get idea on green systems and the environment, energy technology and efficiency, and sustainability.	<b>3.1</b>	Modify processes and products to make them green and safe.	<b>c,e,g,i</b>
<b>4.0</b>	To understand the concept of design on green technology	<b>4.1</b>	Design processes and products using green technology	<b>c,f,g,l</b>
<b>5.0</b>	To acquire knowledge about materials used for green technology	<b>5.1</b>	Interpret advanced technology in green synthesis	<b>e,g,k,l</b>

**UNIT I - PRINCIPLES OF GREEN CHEMISTRY****(9)**

Historical Perspectives and Basic Concepts. The twelve Principles of Green Chemistry and green engineering. Green chemistry metrics- atom economy, E factor, reaction mass efficiency, and other green chemistry metrics, application of green metrics analysis to synthetic plans.

**UNIT II - POLLUTION TYPES****(9)**

Pollution - types, causes, effects, and abatement. Waste - sources of waste, different types of waste, chemical, physical and biochemical methods of waste minimization and recycling.

**UNIT III - GREEN REAGENTS AND GREEN SYNTHESIS****(9)**

Environmentally benign processes- alternate solvents- supercritical solvents, ionic liquids, water as a reaction medium, energy-efficient design of processes- photo, electro and sono chemical methods, microwave-assisted reactions

**UNIT IV - DESIGNING GREEN PROCESSES****(9)**

Safe design, process intensification, in process monitoring. Safe product and process design - Design for degradation, Real-time Analysis for pollution prevention, inherently safer chemistry for accident prevention

**UNIT V - GREEN NANOTECHNOLOGY****(9)**

Nano materials for water treatment, nanotechnology for renewable energy, nanotechnology for environmental remediation and waste management, nanotechnology products as potential substitutes for harmful chemicals, environmental concerns with nanotechnology

**TOTAL (L: 45) = 45 PERIODS****TEXT BOOKS:**

1. B. Billatos, Nadia A. Basaly, Taylor & Francis Samir, "Green Technology and Design for the Environment", Washington, DC, 1997
2. M. Lancaster, "Green Chemistry - An Introductory Text", RSC, 2016.
3. Alexi Lapkin and David Constable (Eds), "Green Chemistry Metrics", Wiley publications, 2008

**REFERENCE:**

1. Stanley E Manahan, Taylor and Francis, "Environmental Chemistry", 2017

**17CEM03 - MATERIALS FOR ENERGY SUSTAINABILITY**

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

**PREREQUISITE : NIL**

**COURSE OBJECTIVES AND OUTCOMES**

<b>Course Objectives</b>		<b>Course Outcomes</b> The students will be able to		<b>Related Program Outcomes</b>
<b>1.0</b>	To Familiarize about the challenges and demands of energy sustainability	<b>1.1</b>	Discuss about energy sustainability	<b>f,g</b>
<b>2.0</b>	To Provide fundamental knowledge about electrochemical devices and the materials used.	<b>2.1</b>	Explain the principles of different electrochemical devices.	<b>b,e,g</b>
<b>3.0</b>	To Introduce the students to various types of fuel cell	<b>3.1</b>	Employ the working of fuel cells and their application	<b>e,f,g</b>
<b>4.0</b>	To appreciate novel materials and their usage in photovoltaic application	<b>4.1</b>	Categorize various Photovoltaic applications and the materials used.	<b>g,k</b>
<b>5.0</b>	To Introduce basic principles of various types Super capacitors and the materials used.	<b>5.1</b>	Assess different types of super capacitors and the performance of various materials	<b>c,g,k</b>

**UNIT I - SUSTAINABLE ENERGY SOURCES**

**(9)**

Introduction to energy demand and challenges ahead - sustainable source of energy (wind, solar etc.) - electrochemical energy systems for energy harvesting and storage - materials for sustainable electrochemical systems building - India centric solutions based on locally available materials - Economics of wind and solar power generators vs. conventional coal plants - Nuclear energy

**UNIT II - ELECTROCHEMICAL DEVICES**

**(9)**

Electrochemical Energy - Difference between primary and secondary batteries - Secondary battery (Li-ion battery, Sodium-ion battery, Li-S battery, Li-O<sub>2</sub> battery, Nickel Cadmium, Nickel Metal Hydride) - Primary battery (Alkaline battery, Zinc-Carbon battery) - Materials for battery (Anode materials - Lithiated graphite, Sodiated hard carbon, Silicon doped graphene, Lithium Titanate) (Cathode Materials - S, LiCoO<sub>2</sub>, LiFePO<sub>4</sub>, LiMn<sub>2</sub>O<sub>4</sub>) - Electrolytes for Lithium-ion battery (ethylene carbonate and propylene carbonate based)

**UNIT III - FUEL CELLS**

**(9)**

Principle of operation of fuel cells - types of fuel cells (Proton exchange membrane fuel cells, alkaline fuel cell, direct methanol fuel cells, direct borohydride fuel cells, phosphoric acid fuel cells, solid oxide fuel cells, and molten carbonate fuel cells) - Thermodynamics of fuel cell - Fuel utilization - electrolyte membrane (proton conducting and anion conducting) - Catalysts ( Platinum, Platinum alloys, carbon supported platinum systems and metal oxide supported platinum catalysts) - Anatomy of fuel cells (gas diffusion layer, catalyst layer, flow field plate, current conductors, bipolar plates and monopolar plates).

**UNIT IV -PHOTOVOLTAICS**

**(9)**

Physics of the solar cell - Theoretical limits of photovoltaic conversion - bulk crystal growth of Si and wafering for photovoltaic application - Crystalline silicon solar cells - thin film silicon solar cells - multi junction solar cells - amorphous silicon based solar cells - photovoltaic concentrators - Cu(InGa)Se<sub>2</sub> solar cells - Cadmium Telluride solar cells - dye sensitized solar cells - Perovskite solar cells - Measurement and characterization of solar cells - Materials used in solar cells (metallic oxides, CNT films, graphene, OD fullerenes, single-multi walled carbon nanotubes, two-dimensional Graphene, organic or Small molecule - based solar cells materials - copper-phthalocyanine and perylenetetra carboxylicbis - benzene - fullerenes - boron subphthalocyanine - tin (II) phthalocyanine)

**UNIT V -SUPERCAPACITORS****(9)**

Super capacitor - types of super capacitors (electrostatic double-layer capacitors, pseudo capacitors and hybrid capacitors) - design of super capacitor-three and two electrode cell-parameters of super capacitor- Faradaic and non - Faradaic capacitance - electrode materials (transition metal oxides (MO), mixed metal oxides, conducting polymers (CP), Mxenes, nanocarbons, non-noble metal, chalcogenides, hydroxides and 1D-3D metal-organic frame work (MOF), activated carbon fibres (ACF)- Hydroxides-Based Materials - Polyaniline (PANI), a ternary hybrid composite-conductive polypyrrole hydrogels - Different types of nano composites for the SC electrodes (carbon-carbon composites, carbon-MOs composites, carbon-CPs composites and MOs-CPs composites) - Two-Dimensional (2D) Electrode Materials - 2D transition metal carbides, carbonitrides, and nitrides.

**TOTAL (L: 45) = 45 PERIODS****TEXT BOOKS:**

1. John A. Kilner, Stephen J. Skinner, Stuart J. C. Irvine and Peter P. Edwards, "Functional materials for sustainable energy applications".
2. Parnia Forouzandeh, Vignesh Kumaravel and Suresh C. Pillai , "Electrode Materials for Supercapacitors: A Review of Recent Advances", Catalysts 2020
3. B.E. Conway, "Electrochemical Super capacitors: Scientific Fundamentals and Technological Applications", Kluwer Academic / Plenum publishers, New York, 1999.

**REFERENCES:**

1. T.R. Crompton, Batteries reference book, Newners, 3<sup>rd</sup> ed., 2002.
2. Wolf Vielstich, Arnold Lamm, Hubert Andreas Gasteiger, Harumi Yokokawa, "Hand Book of Fuel Cells: Fuel Cell Technology and Applications", Wiley, London 2003.
3. B.Viswanathan. M.Aulice Scibioh , "Materials for Supercapacitor Applications".

**17CEM04 - ENVIRONMENT ECOLOGY**

L	T	P	C
3	0	0	3

PREREQUISITE : NIL

**COURSE OBJECTIVES AND OUTCOMES**

Course Objectives		Course Outcomes The students will be able to		Related Program
1.0	To impart knowledge on the basic knowledge about Environment and Ecology.	1.1	Differentiate the various ecosystem and effects of human activities on environment.	b,d,g
2.0	To acquire knowledge on the natural resources and the energy produced.	2.1	Classify the types of natural resources and the sources of energy produced.	f,g
3.0	To get ideas on various environmental pollution and their effects.	3.1	Explain the environment issue based on environmental pollution.	b,c,f
4.0	To acquire knowledge on the various environment quality standards.	4.1	Apply the Environment Quality Standards according to pollution types.	f,g
5.0	To impart knowledge on the environment impact assessment for infrastructure projects.	5.1	Do the Environment Impact Assessment for infrastructure projects.	b,c,g

**UNIT I - FUNDAMENTALS OF ENVIRONMENT AND ECOLOGY****(9)**

Environment - Ecology and Ecosystem - Food chain - Food web - Trophic level - Energy flow - Introduction, types, characteristic features, structure and function - Forest - Grassland - Desert and Aquatic ecosystems - Effects of human activities on environment, Agriculture, Housing, Industry, Mining and Transportation.

**UNIT II - NATURAL RESOURCES****(9)**

Water Resources - Mineral Resources - Soil, Material cycles - Carbon, Nitrogen and Sulphur Cycles - Energy - Different types of energy - Conventional and Non-Conventional sources - Hydro Electric. - Fossil Fuel based, Nuclear, Solar, Biomass and Geothermal energy and Bio-gas.

**UNIT III - ENVIRONMENTAL POLLUTION AND CURRENT ENVIRONMENTAL ISSUES OF IMPORTANCE****(9)**

Concepts of Air Pollution, Water pollution, Land pollution, Noise pollution - Causes, effects and control measures - Climate Change and Global warming effects - Acid Rain, Ozone Layer depletion, Photochemical Smog - Solid waste management and Waste water treatment.

**UNIT IV - ENVIRONMENT QUALITY STANDARDS****(9)**

Ambient air quality standards - Water quality parameters and standards - Turbidity, pH, Suspended solids, hardness, residual chlorine, sulphates, phosphates, iron and manganese, DO, BOD and COD - WHO and BIS norms.

**UNIT V - ENVIRONMENT IMPACT ASSESSMENT****(9)**

Introduction to EIA - Screening, Scoping, Public Participation - EIA for infrastructure projects - Highways - Dams - Multi-storey Buildings - Water Supply and Drainage - Case studies.

**TOTAL (L: 45) = 45 PERIODS**

**TEXT BOOKS:**

1. Pandey SN and Misra SP, "Environment and Ecology", Ane Books Pvt. Ltd, New Delhi, 2018.
2. P.D.Sharma, "Ecology and Environment", Rastogi Publication, 2015.

**REFERENCES:**

1. Shukla, S.K. and Srivastava, P.R., "Concepts in Environmental Impact Analysis", Common Wealth Publishers, New Delhi, 1992.
2. Canter, L.W., "Environmental Impact Assessment", McGraw-Hill Inc., 1997.
3. S. S. Dara, "A Text Book of Environmental Chemistry & Pollution Control", S. Chand and Co., 2004.
4. Samir K. Banerjee, "Environmental Chemistry", Prentice Hall of India Pvt. Ltd. New Delhi, 2009.

**17CEM05 - ENVIRONMENTAL HEALTH AND SAFETY**

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

**PREREQUISITE : NIL****COURSE OBJECTIVES AND OUTCOMES**

<b>Course Objectives</b>		<b>Course Outcomes</b> The students will be able to		<b>Related Program Outcomes</b>
<b>1.0</b>	To understand and study the complexity of the environment in relation to pollutants generated due to industrial activity	<b>1.1</b>	Apply the concept of EHS and their framework.	<b>b,f,g</b>
<b>2.0</b>	To analyze the quality of the environmental parameters and monitor the same for the purpose of environmental risk assessment.	<b>2.1</b>	Identify the monitoring principles in workplace systems.	<b>b,c,g</b>
<b>3.0</b>	Familiarisation on the concept of sustainable development and its benefits	<b>3.1</b>	Choose the need of training and methods of EHS	<b>f,g,h</b>
<b>4.0</b>	Recognize the potential of renewable energy sources and its conversion technologies for attaining sustainable development	<b>4.1</b>	Organize the safety auditing management systems and their prevention techniques.	<b>c,g,i</b>
<b>5.0</b>	Acquainting with energy policies and energy planning for sustainable development	<b>5.1</b>	Identify the key steps involved in HSE legislations.	<b>g,f,k</b>

**UNIT I - OCCUPATION, SAFETY AND MANAGEMENT****(9)**

Occupational Safety - Health and Environmental Safety Management - Principles &amp; practices - Role of Management in Industrial Safety- Organization Behaviour - Human factors contributing to accident.

**UNIT II - MONITORING FOR SAFETY, HEALTH AND ENVIRONMENT****(9)**

Bureau of Indian Standards on Safety and Health: 14489 - 1998 and 15001 - 2000 - ILO and EPA Standards - Principles of Accident - Prevention - Definitions - Incident - accident - injury - dangerous - occurrences - unsafe acts - unsafe conditions - hazards - error - oversight - mistakes.

**UNIT III - EDUCATION, TRAINING AND EMPLOYEE PARTICIPATION IN SAFETY****(9)**

Element of training cycle - Techniques of training, design and development of training programs - Training methods and strategies types of training - Competence Building Techniques (CBT) - Employee Participation: Purpose - methods - Role of trade union in SHE.

**UNIT IV - MANAGEMENT INFORMATION SYSTEM****(9)**

Sources of information on Safety, Health and Environment - Compilation and collation of information - Analysis &amp; use of modern methods of programming - storing and retrieval of MIS for Safety, Health and Environment - QCC HS Computer Software Application and Limitations.

**UNIT V - LEGISLATION ON SAFETY, HEALTH AND ENVIRONMENT****(9)**

Overview of SHE - The factories act, 1948 (Amended) and Rules - Contract Labour Act - Social Accountability - SA 8000 - Water(Prevention and Control of Pollution) Act 1974 and Rules - Air (Prevention &amp; Control of Pollution) Act 1981 and Rules - Environment Protection Act.

**TOTAL (L: 45) = 45 PERIODS****TEXT BOOK:**

- I. Narayanan K.T., "Safety, Health and Environment Handbook", 1st Edition, McGraw Hill, New Delhi, 2017.

**REFERENCES:**

1. Nicholas P.Cheremisinoff & Madelyn L.Graffia, "Environmental and Health & Safety Management- A Guide to Compliance", 1<sup>st</sup> ed., William Andrew Publisher, Norwich, 1995.
2. David Yates W., "Safety Professional's Reference & Study Guide", 2<sup>nd</sup> ed., CRC Press Publishers, New Delhi, 2015.



**17CEM06 - INTRODUCTION TO SMART CITIES**

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

**PREREQUISITE : NIL****COURSE OBJECTIVES AND OUTCOMES**

<b>Course Objectives</b>		<b>Course Outcomes</b> The students will be able to		<b>Related Program Outcomes</b>
<b>1.0</b>	To help the learners to understand the concepts of smart city and to introduce the students about application of technologies in smart cities	<b>1.1</b>	Discuss the importance, features and case histories of smart cities in India	<b>e,f,i,j</b>
<b>2.0</b>	To understand the basics of Urbanisation and the role of smart cities	<b>2.1</b>	Describe mobility and energy in smart city	<b>e,f</b>
<b>3.0</b>	To Understand the role of smart planning for sustainable development.	<b>3.1</b>	Explain water and waste management techniques in smart city	<b>e,h,j,k</b>
<b>4.0</b>	To Gain knowledge on implementation of smart physical infrastructure.	<b>4.1</b>	Model smart environment and smart buildings	<b>b,c,g,i</b>
<b>5.0</b>	To Comprehend knowledge of Technologies in Smart City planning	<b>5.1</b>	Plan e-governance and ICT in smart city	<b>e,f,g,k</b>

**UNIT I - INTRODUCTION****(9)**

Definitions - Evolution - Features and strategies - Challenges - India 100 smart cities policy and mission, smart city planning and development, financing smart cities development. Governance of smart cities - case studies in India.

**UNIT II - SMART URBAN MOBILITY AND SMART ENERGY****(9)**

Need for urban mobility - multiple perspectives - objectives - components - emerging concepts and strategies - ICT supported smart mobility systems - policy priorities. Introduction to smart energy - urban density and energy use - objectives - elements of smart energy management system - strategies - smart grid - challenges.

**UNIT III - WATER AND WASTE MANAGEMENT****(9)**

Smart water management - definitions - water resource and cycle - functions and objectives - steps in implementation - benefits - policy challenges. Smart waste management - approaches and implementation - existing systems - strategies - challenges and policies.

**UNIT IV - SMART ENVIRONMENT AND SMART BUILDINGS****(9)**

Global background of environmental concerns - concept of environmental resources - basic environmental challenges - smart environment - stakeholders - ICT framework for environmental management. Intelligent buildings - objectives - components - systems of smart building - benefits, challenges.

**UNIT V - E- GOVERNANCE AND ICT****(9)**

Governance challenges in new era - history of smart governance - functions and objectives - ICT in governance - system infrastructure - benefits, challenges and future vision. Taxonomy of layers of ICT architecture - major technology areas - components - emerging technologies in ICT - challenges and concerns in ICT.

**TOTAL (L: 45) = 45 PERIODS**

**TEXT BOOKS:**

1. Anilkumar P.P, "Introduction to Smart Cities", 1<sup>st</sup> ed., Pearson India Education Service Pvt Ltd, Noida,Uttar Pradesh, India, 2019.
2. P Sharma , "Sustainable Smart cities in India, Challenges and Future Perspectives", Springer Link, 2017
3. Sameer Sharma, "Smart Cities Unbounded- Ideas and Practice of Smart Cities in India", Bloomsbury India, 2018.

**REFERENCES:**

1. Germaine R. Haleboua, "Smart Cities", 1<sup>st</sup> ed., The MIT Press Essential Knowledge Series, London, England, 2020.
2. Andy Pike, Andres Rodriguez-Pose & John Tomaney, "Handbook of Local and Regional Development", 3<sup>rd</sup> ed., Taylor Francis, United Kingdom, 2010.
3. Binti Singh, ManojParmar, "Smart City in India Urban Laboratory, Paradigm or Trajectory", Routledge India,2019

**17CEM07 - DISASTER PREPAREDNESS AND PLANNING**

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

**PREREQUISITE : NIL****COURSE OBJECTIVES AND OUTCOMES**

<b>Course Objectives</b>		<b>Course Outcomes</b> The students will be able to		<b>Related Program Outcomes</b>
<b>1.0</b>	To impart knowledge on the key concepts in disaster risk reduction and humanitarian response	<b>1.1</b>	Explain different forms of disaster and their causes	<b>g,k</b>
<b>2.0</b>	To impart knowledge on the impact and effects of earthquakes and tsunami	<b>2.1</b>	Identify the causes, effects and precautionary measures of earthquakes and tsunami	<b>f,g</b>
<b>3.0</b>	To impart knowledge on the effects of floods and droughts	<b>3.1</b>	Identify the causes and control measures of flood and droughts	<b>b,c,e,j</b>
<b>4.0</b>	To acquaint with the skills for planning and organizing disaster response	<b>4.1</b>	Choose suitable remedial measures for slope stabilization	<b>d,f</b>
<b>5.0</b>	To acquire knowledge on disaster risk reduction	<b>5.1</b>	Develop a disaster management cycle with disaster risk reduction measures	<b>d,g</b>

**UNIT I - INTRODUCTION TO DISASTERS****(9)**

Definition - Disaster, Hazard, Vulnerability, Resilience, Risks - Disasters: Types of disasters - Earthquake, Landslide, Flood, Drought, Fire, Forest Fire, Industrial and Technological Disasters, Climate Change- Classification, Causes, Impacts - Do's and Don'ts during disaster - Global trends in disasters: urban disasters, pandemics, complex emergencies, Climate change

**UNIT II - EARTHQUAKES AND TSUNAMI****(9)**

Earthquakes - causes of earthquakes - effects - plate tectonics - seismic waves - measures of size of earthquakes - earthquake resistant design concepts. Tsunami - causes - effects - undersea earthquakes - landslides - volcanic eruptions - impact of sea meteorite - remedial measures - precautions - case studies.

**UNIT III - FLOODS AND DROUGHTS****(9)**

Climatic Hazards - Floods - causes of flooding - regional flood frequency analysis - flood control measures - flood routing - flood forecasting - warning systems. Droughts - causes - types of droughts - effects of drought - mitigation - case studies.

**UNIT IV - LANDSLIDES AND SLOPE STABILITY: MANAGEMENT****(9)**

Landslides - Causes - Principles of stability analysis - Remedial and corrective measures for slope stabilization - mitigation - case studies.

**UNIT V - DISASTER PREPAREDNESS AND MANAGEMENT****(9)**

Preparedness: Monitoring of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological and other Agencies, Media Reports: Governmental and Community Preparedness. NDLA, National Disaster Management.

**TOTAL (L: 45) = 45 PERIODS****TEXT BOOKS:**

1. Singhal J.P., "Disaster Management", 1<sup>st</sup> ed., Laxmi Publications, India, 2007
2. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, Issues and Strategies", 1<sup>st</sup> ed. New Royal book Company, 2007.

**REFERENCES:**

1. Gupta M.C., "Manual on Natural Disaster Management in India", NIDM, New Delhi, 2000.
2. "National Disaster Management Policy", Government of India, 2009

**17CEM08 - ENERGY EFFICIENCY FOR SUSTAINABLE DEVELOPMENT**

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

**PREREQUISITE : NIL**

**COURSE OBJECTIVES AND OUTCOMES**

<b>Course Objectives</b>		<b>Course Outcomes</b> The students will be able to		<b>Related Program Outcomes</b>
<b>1.0</b>	To understand the types of energy sources, energy efficiency and environmental implications of energy utilisation	<b>1.1</b>	Relate the prevailing energy scenario	<b>b,d</b>
<b>2.0</b>	To create awareness on energy audit and its impacts	<b>2.1</b>	Familiarise on energy audits and its relevance	<b>g,i,k</b>
<b>3.0</b>	To acquaint the techniques adopted for performance evaluation of thermal utilities	<b>3.1</b>	Apply the concept of energy audit on thermal utilities	<b>f,i</b>
<b>4.0</b>	To familiarise on the procedures adopted for performance evaluation of electrical utilities	<b>4.1</b>	Employ relevant techniques for energy improvement in electrical utilities	<b>c,f,l,k</b>
<b>5.0</b>	To learn the concept of sustainable development and the implication of energy usage	<b>5.1</b>	Realize Sustainable development and its impact on human resource development	<b>a,d,g</b>

**UNIT I - ENERGY AND ENVIRONMENT**

**(9)**

Primary energy sources - Coal, Oil, Gas - India Vs World with respect to energy production and consumption, Climate Change, Global Warming, Ozone Depletion, UNFCCC, COP

**UNIT II - ENERGY AUDITING**

**(9)**

Need and types of energy audit. Energy management (audit) approach - understanding energy costs, bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel & energy substitution, energy audit instruments

**UNIT III - ENERGY EFFICIENCY IN THERMAL UTILITIES**

**(9)**

Energy conservation avenues in steam generation and utilisation, furnaces, Thermic Fluid Heaters. Insulation and Refractories - Commercial waste heat recovery devices: recuperator, regenerator, heat pipe, heat exchangers (Plate, Shell & Tube), heat pumps, and thermo compression

**UNIT IV - ENERGY CONSERVATION IN ELECTRICAL UTILITIES**

**(9)**

Demand side management - Power factor improvement - Energy efficient transformers - Energy conservation avenues in Motors, HVAC, fans, blowers, pumps, air compressors, illumination systems and cooling towers

**UNIT V - SUSTAINABLE DEVELOPMENT**

**(9)**

Sustainable Development: Concepts and Stakeholders, Sustainable Development Goal (SDG). Globalization and Economic growth. Economic development: Economic inequalities, Income and growth. Social development: Poverty, conceptual issues and measures, impact of poverty

**TOTAL (L: 45) = 45 PERIODS**

**TEXT BOOKS:**

1. Pratap Bhattacharyya, "Climate Change and Greenhouse Gas Emission", New India Publishing Agency- Nipa,2020
2. Matthew John Franchetti , Defne Apul "Carbon Footprint Analysis: Concepts, Methods, Implementation, and Case Studies" CRC Press,2012
3. Robert A. Ristinen, Jack J. Kraushaar, Jeffrey T. Brack, "Energy and the Environment", 4<sup>th</sup> ed.,Wiley,2022

**REFERENCES:**

1. Energy Manager Training Manual (4 Volumes) available at <http://www.em-ea.org/gbook1.asp>, a website administered by Bureau of Energy Efficiency (BEE), a statutory body under Ministry of Power, Government of India.2004
2. Eastop.T.D& Croft D.R, "Energy Efficiency for Engineers and Technologists", Logman Scientific & Technical, 1990
3. W.R. Murphy and G. McKay "Energy Management" Butterworths, London 1987





# NANDHA ENGINEERING COLLEGE

(Autonomous)

Affiliated to Anna University Chennai + Approved by AICTE + Accredited by NAAC (A+ Grade)

Pitchandampalayam (P.O), Valkkalmedu, Erode - Perundural Road, Erode - 638 052

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Website : [www.nandhaengg.org](http://www.nandhaengg.org)

E.mail : [info@nandhaengg.org](mailto:info@nandhaengg.org)

## 1.1.2 Details of Courses Where Syllabus was carried out in

### B.E Civil Engineering (R22)

S.No	Course Code	Course Name	% of change
1.	22EYA01	Professional Communication - I	40
2.	22MYB01	Calculus and Linear Algebra	10
3.	22CYB02	Chemistry for Engineers	30
4.	22CYP01	Chemistry Laboratory	20
5.	22EYA02	Professional Communication- II	30
6.	22MYB02	Partial Differential Equations and Transform Techniques	10
7.	22PYB02	Advanced Materials and Nanotechnology	60
8.	22PYP01	Physics Laboratory	10
9.	22CYB08	Environment and Sustainability	55
10.	22GYA01	Heritage of Tamils	100
11.	22GYA02	Tamils and Technology	100
12.	22MYB03	Statistics and Numerical Methods	50
13.	22CEC05	Construction Materials and Practices	40
14.	22CEP03	Computer Aided Building Drawing - II	20
Average			41.07%



  
**PRINCIPAL**  
Nandha Engineering College  
(Autonomous)  
Erode - 638 052.

22EYA01 - PROFESSIONAL COMMUNICATION - I (Common to All Branches)					
		<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>2</b>	<b>0</b>	<b>2</b>	<b>3</b>
<b>PREREQUISITE : NIL</b>					
<b>Course Objectives</b>			<b>Course Outcomes</b>		
<b>1.0</b>	To build essential English skills to address the challenges of communication in today's work environment.		<b>1.1</b>	The students will be able to apply knowledge of communication and language processes occur in various work environment.	
<b>2.0</b>	To comprehend the various dimensions of communication by employing LSRW skills.		<b>2.1</b>	The students will be able to involve in diverse discourse forms utilizing LSRW skills.	
<b>3.0</b>	To deploy students in contextual initiatives by assisting them in developing communication abilities.		<b>3.1</b>	The students will be able to participate actively in communication activities that enhance their creative skill.	
<b>4.0</b>	To facilitate students in comprehending the intent, target audience and environments of various forms of communication.		<b>4.1</b>	The students will be able to associate with the target audience and contexts using varied types of communication.	
<b>5.0</b>	To enhance coherence, cohesion, and proficiency in both verbal and nonverbal communication in the workplace environment.		<b>5.1</b>	The students will be able to convey the idea distinctly both in verbal and non verbal communication in work culture.	

<b>UNIT I - INTRODUCTORY SKILLS</b>	<b>(6+6)</b>
<b>Grammar</b> - Parts of Speech - Verb (Auxiliaries - Primary & Modal, Main Verb) - <b>Listening</b> - Listening to Short Conversations or Monologues - Listening to Experiences - Listening to Descriptions - <b>Speaking</b> - Introducing Oneself - Exchanging Personal information - Talking about food and culture - <b>Reading</b> - Reading for Interrogation - Reading Newspaper, Advertisements and Interpreting - <b>Writing</b> - Seeking Permission for Industrial Visit & In-plant Training	
<b>UNIT II - LANGUAGE ACUMEN</b>	<b>(6+6)</b>
<b>Grammar</b> - Word Formation - Tenses (Present Tense) - Synonyms & Antonyms - <b>Listening</b> - Listening to Announcements - Listening to Interviews - Listening and Note-taking - <b>Speaking</b> - Talking about Holidays & Vacations - Narrating Unforgettable Anecdotes - <b>Reading</b> - Skimming - Scanning (Short Texts and Longer Passages) - Critical Reading - <b>Writing</b> - Instruction - Process Description	
<b>UNIT III - COMMUNICATION ROOTERS</b>	<b>(6+6)</b>
<b>Grammar</b> - Cause and Effect - Tenses (Past Tense) - Discourse Markers - <b>Listening</b> - Listening to Telephonic Conversations - Listening to Podcasts - <b>Speaking</b> - Talking about neoteric Technologies - Eliciting information to fill a form - <b>Reading</b> - Book Reading (Motivational) - Practicing Speed Reading (reading newspaper reports & biographies) - <b>Writing</b> - Checklist - Circular, Agenda & Minutes of the Meeting	
<b>UNIT IV - DISCOURSE FORTE</b>	<b>(6+6)</b>



**Grammar** - Tenses (Future Tense) - Yes/No & WH type questions - Negatives - **Listening** - Listening to TED/ Ink talks -**Speaking** - Participating in Short Conversations - **Reading** - Reading Comprehension (Multiple Choice / Short / Open Ended Questions) - **Writing** - E-Mail Writing

**UNIT V - LINGUISTIC COMPETENCIES**

**(6+6)**

**Grammar** - Articles - Homophones & Homonyms - Single line Definition - Phrasal Verb - **Listening** - Intensive listening to fill in the gapped text - **Speaking** - Expressing opinions through Situations & Role play **Reading** - Cloze Texts - **Writing** - Paragraph Writing

**LIST OF SKILLS ASSESSED IN THE LABORATORY**

1. Grammar
2. Listening Skills
3. Speaking Skills
4. Reading Skills
5. Writing Skills

**TOTAL (L:30, P:30) = 60 PERIODS**

**TEXT BOOK:**

1. Shoba K N., Deepa Mary Francis, "English for Engineers and Technologists", Volume I, 3rd Edition, Orient Black Swan Pvt. Ltd, Telangana, 2022.

**REFERENCES:**

1. Koneru, Aruna, "English Language Skills", Tata McGraw Hill Education (India) Private Limited, Chennai, 2006.
2. Hewings M, "Advanced English Grammar", Cambridge University Press, Chennai, 2000.
3. Jack C Richards, Jonathan Hull and Susan Proctor, "Interchange", Cambridge University Press, New Delhi, 2015 (Reprint 2021).

Mapping of COs with POs / PSOs														
Cos	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1									3	3		2	2	
2									3	3		2	2	
3									3	3		2	2	
4									3	3		2	2	
5									3	3		2	2	
<b>CO (W.A)</b>									<b>3</b>	<b>3</b>		<b>2</b>	<b>2</b>	

<b>22MYB01- CALCULUS AND LINEAR ALGEBRA</b>				
<i>(Common to All Branches)</i>				
		<b>L</b>	<b>T</b>	<b>P</b>
		<b>3</b>	<b>1</b>	<b>0</b>
<b>PRE REQUISITE : NIL</b>				
<b>Course Objectives</b>		<b>Course Outcomes</b>		
<b>1.0</b>	To develop the use of matrix algebra techniques needed by engineers for practical applications.	<b>1.1</b>	The students will be able to apply the concept of orthogonal reduction to diagonalise a given matrix.	
<b>2.0</b>	To use the techniques, skills and engineering tools necessary for engineering practice, with geometric concepts.	<b>2.1</b>	The students will be able to identify the geometric aspects of plane, straight line and sphere.	
<b>3.0</b>	To improve the ability of the students in solving geometrical applications of differential calculus problems.	<b>3.1</b>	The students will be able to evaluate the radius of curvature, circle of curvature and centre of curvature for a given curve.	
<b>4.0</b>	To learn the important role of mathematical concepts in engineering applications with the functions of several variables.	<b>4.1</b>	The students will be able to calculate the maxima and minima for a given function with several variables by finding the stationary points.	
<b>5.0</b>	To acquaint the student with mathematical tools needed in evaluating multiple integrals and their applications.	<b>5.1</b>	The students will be able to evaluate the area and volume by double and triple integrals.	
<b>UNIT I - MATRICES</b>				<b>(9+3)</b>
Characteristic Equation - Eigen values and Eigen vectors of a matrix - Cayley Hamilton Theorem (excluding proof) and its applications - Quadratic form-Reduction of a Quadratic form to canonical form by orthogonal transformation.				
<b>UNIT II - ANALYTICAL GEOMETRY OF THREE DIMENSIONS</b>				<b>(9+3)</b>
Equation of plane - Angle between two planes - Equation of straight lines - Coplanar lines - Equation of sphere - Orthogonal spheres.				
<b>UNIT III - GEOMETRICAL APPLICATIONS OF DIFFERENTIAL CALCULUS</b>				<b>(9+3)</b>
Curvature - Curvature in Cartesian co-ordinates - Centre and Radius of curvature - Circle of curvature - Evolutes and Involutives.				
<b>UNIT IV - FUNCTIONS OF SEVERAL VARIABLES</b>				<b>(9+3)</b>
Partial derivatives - Euler's theorem on homogeneous function - Jacobian - Maxima and Minima of functions of two variables - Constrained Maxima and Minima by Lagrange's multiplier method.				
<b>UNIT V - MULTIPLE INTEGRALS</b>				<b>(9+3)</b>
Double integration in Cartesian Co-ordinates - Change of order of integration - Area as double integral - Triple integration in Cartesian Co-ordinates - Volume as triple integrals.				
<b>TOTAL (L:45+T:15) :60 PERIODS</b>				

**LIST OF PROGRAMS USING MATLAB (Assignment/Online Test):**

1. Introduction to MATLAB
2. Matrix operations - Addition, Multiplication, Transpose and Inverse
3. Characteristic equation of a Matrix
4. Eigen values and Eigen vectors of Higher order Matrices.
5. Curve Tracing
6. Determining Maxima and Minima of a function of one variable.
7. Determining Maxima and Minima of a function of two variables.
8. Evaluating double integrals
9. Evaluating triple integrals
10. Finding area between two curves.

**TEXT BOOKS:**

1. Dr.B.S.Grewal, "Higher Engineering Mathematics", 42nd Edition, Khanna publications, 2012.
2. Erwin Kreyszig, "Advanced Engineering Mathematics, 9th Edition, John Wiley & sons, 2013
3. Veerarajan.T, "Engineering Mathematics of Semester I & II", 3rd Edition, Tata McGraw Hill., 2016

**REFERENCES:**

1. N.P.Bali, Manish Goyal, "A Text book of Engineering Mathematics -Sem-II", 6th Edition, Laxmi Publications, 2014.
2. Kandasamy.P, Thilagavathy.K, Gunavathy .K, "Engineering Mathematics for first year", 9th Rev.Edition, S.Chand & Co Ltd, 2013.
3. Glyn James, "Advanced Engineering Mathematics", 7th Edition, Wiley India, 2007.

**Mapping of COs with POs / PSOs**

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	2	2		1				1		2	2	2	1
2	3	2	2		1	1			1			2	2	
3	3	2	2		1							2	2	
4	3	2	2	1	1				1			2	2	
5	3	2	2	1	1				1		1	2	2	1
<b>CO (W.A)</b>	3	2	2	1	1	1			1		1.5	2	2	1



\*Approved by Eleventh Academic Council

22CYB02 - CHEMISTRY FOR ENGINEERS (Common to CIVIL and MECH Branches)				
			<b>L</b>	<b>T</b>
			<b>3</b>	<b>0</b>
			<b>P</b>	<b>C</b>
			<b>0</b>	<b>3</b>
<b>PRE REQUISITE : NIL</b>				
Course Objectives		Course Outcomes		
<b>1.0</b>	To recognize the basic concepts of electrochemistry and understand electrochemical processes.	<b>1.1</b>	The student will be able to evaluate fundamentals of electrochemistry, electrodes, cells and electrode potentials.	
<b>2.0</b>	To facilitate the students to achieve a clear conceptual understanding of technical and commercial aspects of energy sources and storage devices.	<b>2.1</b>	The student will be able to impart knowledge on renewable energy sources like nuclear, solar, wind energy and also on storage devices.	
<b>3.0</b>	To make the students conversant with water treatment, boiler feed water techniques	<b>3.1</b>	The student will be able to identify the various water treatment techniques for domestic and industrial purpose.	
<b>4.0</b>	To elucidate the mechanism of corrosion and their control measures.	<b>4.1</b>	The student will be able to explore the type of corrosion and depict the methods of corrosion control.	
<b>5.0</b>	To impart knowledge on the basic principles, types of fuels, their preparation, properties and combustion characteristics.	<b>5.1</b>	The student will be able to recommend suitable fuels for engineering processes and applications.	

<b>UNIT I – ELECTROCHEMISTRY</b>	<b>(9)</b>
Electrode potential - Nernst equation - derivation and problems - reference electrodes - standard hydrogen electrode - calomel electrode - electrochemical series - significance - Types of cell - electrolytic and electrochemical cells - reversible and irreversible cells - potentiometric titrations (redox) - conductometric titrations (acid-base).	
<b>UNIT II - ENERGY SOURCES AND STORAGE DEVICES</b>	<b>(9)</b>
Nuclear energy - nuclear fission - nuclear fusion - light water nuclear power plants - breeder reactor - solar energy conversion - solar cells - solar water heater - Recent developments in solar cell materials - wind energy - batteries - types of batteries - lead acid storage battery - lithium-ion battery, Electric vehicles - working principles.	
<b>UNIT III - WATER TECHNOLOGY AND NANO MATERIALS</b>	<b>(9)</b>
Municipal water treatment - disinfection methods (uv, ozonation, chlorination) - desalination of brackish water - reverse osmosis - boiler troubles (scale, sludge, priming, foaming and caustic embrittlement) - treatment of boiler feed water - internal treatment (carbonate, phosphate and calgon conditioning) - external treatment - demineralization process. Nanomaterials - synthesis (laser ablation, and chemical vapour deposition method) and applications of nanomaterials.	
<b>UNIT IV - CORROSION AND ITS CONTROL</b>	<b>(9)</b>
Corrosion - types - chemical corrosion - pilling bedworth rule - electrochemical corrosion - mechanism-galvanic corrosion - differential aeration corrosion - factors influencing corrosion - corrosion control - sacrificial anode and impressed cathodic current methods - corrosion inhibitors - protective coatings - paints - constituents and their functions	

<b>UNIT V - FUELS AND COMBUSTION</b>	<b>(9)</b>
<p>Fuels: Introduction: Classification of fuels: Coal and coke: Analysis of coal (Proximate) - Carbonization - Manufacture of metallurgical coke (Otto Hoffmann method). Petroleum and Diesel: Manufacture of synthetic petrol (Bergius process) - Knocking - octane number - diesel oil - cetane number: Power alcohol and biodiesel.</p> <p>Combustion of fuels: Introduction: Calorific value - higher and lower calorific values, Flue gas analysis - ORSAT method. CO<sub>2</sub> emission and carbon foot print.</p>	
<b>TOTAL (L:45) : 45 PERIODS</b>	

<b>TEXT BOOKS:</b>
<ol style="list-style-type: none"> <li>1. Dr.Ravikrishnan, A,"Engineering Chemistry I &amp; Engineering Chemistry II", Sri Krishna Hitech Publishing chem., Co. Pvt Ltd., 13th Edition, Chennai, 2020.</li> <li>2. S.S. Dara," A Text book of Engineering Chemistry", S.Chand &amp; Co.Ltd. New Delhi, 2019.</li> </ol>
<b>REFERENCES:</b>
<ol style="list-style-type: none"> <li>1. P.C.Jain and Monica Jain, "Engineering Chemistry", Vol I &amp;II, Dhanpat Rai Pub, Co, New Delhi, 15th Edition, 2018.</li> <li>2. B.Sivasankar, "Engineering Chemistry", Tata McGraw- Hill Pub.Co.Ltd., New Delhi, 2018</li> </ol>

Mapping of COs with POs / PSOs														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	2	1	3			1			1			2		
2	2	1	3			1	1		1			2	1	
3	2		3			1			2			2		
4	2	2	3			1	2					2	1	
5	2	2	3			1						2		
<b>CO (W.A)</b>	<b>2</b>	<b>2</b>	<b>3</b>			<b>1</b>	<b>1.5</b>		<b>1.33</b>			<b>2</b>	<b>1</b>	

*S. V. Narayan*

**22CYP01- CHEMISTRY LABORATORY**  
(Common to AGRI,BME,CHEM,CIVIL,ECE,EEE and MECH Branches)

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>

**PRE REQUISITE : NIL**

Course Objectives		Course Outcomes	
<b>1.0</b>	To explain the origin of hardness, alkalinity, and chloride and dissolved oxygen in water.	<b>1.1</b>	The students will be able to acquire practical skills in the determination of water quality parameters through volumetric analysis
<b>2.0</b>	To determine the copper in brass in the given solution.	<b>2.1</b>	The students will be able to evaluate the amount of copper in the given analyze by titration method.
<b>3.0</b>	Enable the students to acquire knowledge of conductometric titrations and their calculations.	<b>3.1</b>	The students will be able to gain the knowledge about conductance of ions.
<b>4.0</b>	To perform a potentiometric titration and pH of an acidic solution of known Normality.	<b>4.1</b>	The students will be able to analyze and gain experimental skill about activity of hydrogen ions and measures the voltage
<b>5.0</b>	To know about pH of the solution and how to measure pH using pH meter.	<b>5.1</b>	The students will be able to utilize the fundamental laboratory techniques for analyses such as pH of acidic, basic and neutral solution.

**LIST OF EXPERIMENTS ( Any Five)**

1. Determination of total, temporary & permanent hardness of water by EDTA method.
2. Determination of alkalinity in water sample.
3. Determination of chloride content of water sample by Argentometric method.
4. Determination of DO content of water sample by Winkler's method.
5. Estimation of copper in brass by EDTA.
6. Conductometric titration of strong acid Vs strong base.
7. Estimation of iron content of the given solution using potentiometer.
8. Determination of strength of given hydrochloric acid using pH meter.

**Total (P:30) = 30 periods**

Mapping of COs with POs / PSOs														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	2	1		1	1	1					1	1	1	
2	2	1		1		1	2				1	1		
3	2			1		1	2				1	1		
4	2			1	2	1	2				1	1	1	
5	2	2		1		1	2					1		
<b>CO (W.A)</b>	<b>2</b>	<b>1</b>		<b>1</b>	<b>2</b>	<b>1</b>	<b>2</b>				<b>1</b>	<b>1</b>	<b>1</b>	

*Dr. M. R. S. R.*

- Approved by Eleventh Academic Council

22EYA02 - PROFESSIONAL COMMUNICATION - II (Common to All Branches)					
		<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		2	0	2	3
<b>PREREQUISITE : 22EYA01</b>					
<b>Course Objectives</b>			<b>Course Outcomes</b>		
<b>1.0</b>	To familiarize the students with the basic structures of English and to train them to use these elements correctly in speaking and writing	<b>1.1</b>	The students will be able to frame sentences both in written and spoken forms with accuracy and fluency.		
<b>2.0</b>	To acquire proficiency in LSRW skills on par with the expectations of the industry.	<b>2.1</b>	The students will be able to attain and enhance competence in the four modes of literacy: Listening, Speaking, Reading and Writing.		
<b>3.0</b>	To enable students to adopt strategies for enhancing vocabulary, language and fluency and to deliver professional presentations.	<b>3.1</b>	The students will be able to gain essential competency to express one's thoughts orally and in writing in a meaningful way.		
<b>4.0</b>	To communicate effectively in an academic setting using the language skills as tools.	<b>4.1</b>	The students will be able to use linguistic structures to read and understand well-structured texts encountered in academic or social contexts.		
<b>5.0</b>	To acquire necessary language skills to follow and comprehend discourse such as lectures conversations, interviews, and discussions.	<b>5.1</b>	The students will be able to perform various tasks, such as role plays, debates, group discussions apart from the use of correct spelling and punctuation.		

<b>UNIT I - LANGUAGE RUDIMENTS</b>	<b>(6+6)</b>
<b>Grammar</b> - Active and Passive Voice – Impersonal Passive Voice - Numerical Expressions - <b>Listening</b> - Listening for Specific Information and Match / Choose / Fill in the texts - <b>Speaking</b> - Describing a Person - Making Plans - <b>Reading</b> - Intensive Reading - <b>Writing</b> - Job Application with Resume	
<b>UNIT II - RHETORIC ENHANCERS</b>	<b>(6+6)</b>
<b>Grammar</b> – Reported Speech – Infinitive and Gerund - <b>Listening</b> – Listening to Iconic Speeches and making notes - Listening news / documentaries - <b>Speaking</b> –Talking over Phone – Narrating Incidents - <b>Reading</b> – Extensive Reading (Motivational Books) - <b>Writing</b> – Recommendation	
<b>UNIT III -TECHNICAL CORRESPONDENCE</b>	<b>(6+6)</b>
<b>Grammar</b> – If Conditionals – Blended Words - <b>Listening</b> – Listening to business conversation on audio and video of Short Films, News, Biographies - <b>Speaking</b> – Synchronous communication and Asynchronous communication - Opportunities and threats in using digital platform- <b>Reading</b> - Finding key information in a given text - <b>Writing</b> –Netiquettes- Inviting Dignitaries - Accepting & Declining Invitation	
<b>UNIT IV - CORPORATE COMMUNICATION</b>	<b>(6+6)</b>
<b>Grammar</b> – Concord – Compound Words - <b>Listening</b> – Listening to Roles and Responsibilities in Corporate - Listening to technical videos - <b>Speaking</b> – Introduction to Technical Presentation - Story Telling - <b>Reading</b> – Reading and Understanding Technical Articles - <b>Writing</b> – Report Writing (Accident, Survey and feasibility)	
<b>UNIT V - LANGUAGE BOOSTERS</b>	<b>(6+6)</b>
<b>Grammar</b> - Idiomatic Expressions – Relative Clauses – Confusable words - <b>Listening</b> – Listening to different kinds of Interviews - Listening to Group Discussion - <b>Speaking</b> – Group Discussion - <b>Reading</b> – Reading and Interpreting Visual Materials - <b>Writing</b> – Analytical Paragraph Writing	



### LIST OF SKILLS ASSESSED IN THE LABORATORY

1. Grammar
2. Listening Skills
3. Speaking Skills
4. Reading Skills
5. Writing Skills

**TOTAL (L:30 , P:30 ) = 60 PERIODS**

**TEXT BOOK:**

1. Sudharshana, N.P and Saveetha.C, “English for Technical Communication”, Cambridge University Press, New Delhi, 2016 (Reprint 2017).

**REFERENCES:**

1. Rizvi, M Ashraf, “Effective Technical Communication”, 2nd Edition, McGraw Hill Education India Pvt Ltd, 2017.
2. Rodney Huddleston, Geoffrey K. Pullum and Brett Reynolds, “A Student's Introduction to English Grammar”, 2nd Edition, Cambridge University Press, New Delhi, 2022

**WEB REFERENCE:**

1. <http://youtu.be/URtdGiutVew>

#### Mapping of COs with POs / PSOs

Cos	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1									3	3		2	2	
2									3	3		2	2	
3									3	3		2	2	
4									3	3		2	2	
5									3	3		2	2	
<b>CO (W.A)</b>									<b>3</b>	<b>3</b>		<b>2</b>	<b>2</b>	

S. J. M. S. S. S.

<b>22MYB02 - PARTIAL DIFFERENTIAL EQUATIONS AND TRANSFORM TECHNIQUES</b> (Common to AGRI,CIVIL.CHEM, MECH Branches)				
		<b>L</b>	<b>T</b>	<b>P</b>
		<b>3</b>	<b>1</b>	<b>0</b>
<b>PRE REQUISITE : NIL</b>				
<b>Course Objectives</b>		<b>Course Outcomes</b>		
<b>1.0</b>	To understand the concept of Fourier series and enhance the problem solving skills.	<b>1.1</b>	The students will be able to analysis the Fourier series problem	
<b>2.0</b>	To acquire knowledge of Partial Differential Equations.	<b>2.1</b>	The students will be able to know the formation of partial differential equations and types of solutions.	
<b>3.0</b>	To solve different forms of wave and heat equations	<b>3.1</b>	The students will be able to apply the partial differential equations to solve boundary value problems.	
<b>4.0</b>	To gain the concept of Fourier transforms techniques used in wide variety of situations.	<b>4.1</b>	The students will be able to solve the problems using Fourier transforms and convolution theorem technique.	
<b>5.0</b>	To apply the concepts of Laplace transforms & its applications to various problems related to Engineering	<b>5.1</b>	The students will be able to simplify calculations in system modeling	
<b>UNIT I - FOURIER SERIES</b>				<b>(9+3)</b>
Dirichlet's condition - Fourier series: Half range sine series - Half range cosine series - Parseval's identity for half range series - Root mean square value of a function - Harmonic analysis.				
<b>UNIT II - PARTIAL DIFFERENTIAL EQUATIONS</b>				<b>(9+3)</b>
Formulation of partial differential equations by eliminating arbitrary constants and functions - Solution of standard types first order partial differential equations of the type $f(p,q)=0$ , Clairaut's form - Lagrange's linear equations - Linear partial differential equation of second and higher order with constant coefficient of homogeneous types.				
<b>UNIT III - APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS</b>				<b>(9+3)</b>
Classification of second order quasi linear partial differential equations - Solution of one dimensional wave equation (Zero and non-zero velocity) - One dimensional heat equation (Temperature reduced to zero and non zero boundary conditions) - Steady state solution of two dimensional heat equation(Finite and infinite plate).				
<b>UNIT IV - FOURIER TRANSFORM</b>				<b>(9+3)</b>
Fourier integral theorem(Statement only) - Fourier transform pair - Sine and Cosine transforms - Properties -Transforms of simple functions - Convolution theorem - Parseval's identity(Excluding proof).				
<b>UNIT V - LAPLACE TRANSFORM</b>				<b>(9+3)</b>
Condition for existence - Transforms of Elementary functions - Basic Properties - First & Second Shifting Theorems (Statement only) - Initial and Final value Theorems. Inverse Laplace transforms - Convolution theorem (Excluding proof) - Solution of linear second order ordinary differential equations with constant coefficients using Laplace transform.				
<b>TOTAL (L:45+T:15) :60 PERIODS</b>				

<b>TEXT BOOKS:</b>
<ol style="list-style-type: none"> <li>1. Veerajan.T,"Engineering Mathematics (for semester III), 3rd ed., Tata Mc Graw Hill, New Delhi.</li> <li>2. Kandasamy.P, Thilagavathy.K, and Gunavathy.K., "Engineering Mathematics; Volume III", S.Chand&amp; Co Ltd., 2008.</li> <li>3. Grewal B.S, "Higher Engineering Mathematics", 42nd ed., Khanna publishers, New Delhi, 2012.</li> </ol>
<b>REFERENCES:</b>
<ol style="list-style-type: none"> <li>1. Goyal Manish and Bali.N.P,"A Text book of Engineering mathematics", 6th ed.,Laxmi Publication (P) Ltd,New Delhi, 2012.</li> <li>2. Kreyszig, Erwin,"Advanced Engineering Mathematics", 9th ed., Wiley Publications, New Delhi, 2006.</li> <li>3. Singaravelu.A,"Transforms and Partial Differential Equations", Reprint Edition 2013, Meenakshi Publications, Tamilnadu.</li> </ol>
<b>WEB REFERENCES:</b>
<ol style="list-style-type: none"> <li>1. <a href="https://youtu.be/HCHnXuQ2oME">https://youtu.be/HCHnXuQ2oME</a></li> <li>2. <a href="https://www.youtube.com/watch?v=LYsIBqjQTdl&amp;list=PLF6061160B55B0203&amp;index=1">https://www.youtube.com/watch?v=LYsIBqjQTdl&amp;list=PLF6061160B55B0203&amp;index=1</a></li> <li>3. <a href="https://www.youtube.com/watch?v=9DgjiyRNw1g">https://www.youtube.com/watch?v=9DgjiyRNw1g</a></li> <li>4. <a href="https://youtu.be/lkAvgVUvYvY">https://youtu.be/lkAvgVUvYvY</a></li> <li>5. <a href="https://www.youtube.com/watch?v=8oE1shAX96U&amp;list=PLnVYEPTNGNtVH5YLVJsA2WxWXk6bAps-D&amp;index=1">https://www.youtube.com/watch?v=8oE1shAX96U&amp;list=PLnVYEPTNGNtVH5YLVJsA2WxWXk6bAps-D&amp;index=1</a></li> </ol>

Mapping of COs with POs / PSOs														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	2	1	1					1			2		
2	3	2	1	1					1			2		
3	3	2	1	1					1			2		
4	3	2	1	1					1			2		
5	3	2	1	1					1			2		
<b>CO (W.A)</b>	3	2	1	1					1			2		

*Dr. M. Srinivas Reddy*

\* Approved by Eleventh Academic Council

**22PYB02 - ADVANCED MATERIALS AND NANO TECHNOLOGY**  
(Common to AGRI, CIVIL and CHEM Branches)

		L	T	P	C
		3	0	0	3
<b>PREREQUISITE : NIL</b>					
Course Objectives		Course Outcomes			
1.0	To gain adequate information about the properties of matter.	1.1	The students will be able to understand the fundamental concepts of properties of matter		
2.0	To obtain the knowledge regarding the basics of thermal physics.	2.1	The students will be able to acquire knowledge about the basics of thermal physics.		
3.0	To gain knowledge about the synthesis and properties of nanostructures.	3.1	The students will be able to explore the knowledge of synthesising methods and properties of nanostructures.		
4.0	To expose the concepts of Photonics and fiber optics.	4.1	The students will be able to get adequate information about Photonics and fiber optics in the field of electrical and communication.		
5.0	To update the recent development in Advanced new engineering materials	5.1	The students will be able to acquire knowledge about recent developments in Advanced new engineering materials		

<b>UNIT I - PROPERTIES OF MATTER</b>	<b>(9)</b>
Elasticity - Hooke's law Stress-strain diagram and its uses - factors affecting elastic modulus and tensile strength - torsional stress and deformations - twisting couple - torsion pendulum: theory and experiment - bending of beams - bending moment - cantilever: theory and experiment - uniform and non-uniform bending: theory and experiment - I-shaped girders - stress due to bending in beams.	
<b>UNIT II - THERMAL PHYSICS</b>	<b>(9)</b>
Mode of heat transfer-thermal conductivity - Newton's law of cooling - thermal conduction through compound media (bodies in series and parallel) - thermal conductivity of a good conductor - Forbe's method - thermal conductivity of bad conductor - Lee's disc - Hazards - Seismology and Seismic waves Cyclone and flood hazards - Fire hazards and fire protection, fire - proofing of materials, fire safety regulations and firefighting equipment. Prevention and safety measures.	
<b>UNIT III - SYNTHESIS AND PROPERTIES OF NANOSTRUCTURES</b>	<b>(9)</b>
Introduction to Nanoscience -Types of nanostructure and properties of Nanomaterials - Synthesis and preparation of Nanomaterials - Nanosensors - Biosensors - Nanoscience and Environment.	
<b>UNIT IV - PHOTONICS AND FIBER OPTICS</b>	<b>(9)</b>
<p><b>Photonics:</b> Population of energy levels – Einstein's A and B coefficients derivation - Resonant cavity - Types of lasers - solid state laser (Neodymium) - gas laser (CO<sub>2</sub>) Applications of lasers in science - Engineering - Medicine.</p> <p><b>Fibre optics:</b> Principle, numerical aperture and acceptance angle - Types of optical fibres (Material, refractive index and mode) - Losses in optical fibre - Fibre optic communication Fibre optic sensors (pressure and displacement).</p>	

<b>UNIT V - ADVANCED NEW ENGINEERING MATERIALS</b>	<b>(9)</b>
Ceramics - types and applications - composites: classification, role of matrix and reinforcement, processing of fiber reinforced plastics - metallic glasses: types, glass forming ability of alloys, melt spinning process, applications - shape memory alloys: phases, shape memory effect, pseudoelastic effect, NiTi alloy, application - Bio material - applications.	
<b>TOTAL (L: 45) = 45 PERIODS</b>	
<b>TEXT BOOKS:</b>	
<ol style="list-style-type: none"> <li>1. Dattuprasad, Ramanlal Joshi, "Engineering Physics" Tata McGraw hill education, 2019.</li> <li>2. V.Rajendran," Engineering Physics", Tata McGraw-Hill. New Delhi.2017.</li> <li>3. Marikani, "Materials Science", PHI Learning Private Limited, Eastern Economy Edition, 2018.</li> </ol>	
<b>REFERENCES:</b>	
<ol style="list-style-type: none"> <li>1. Subrahmanyam N, Brijlal, "A Text Book of Optics" S.Chand &amp; Co. Ltd, New Delhi, 2017.</li> <li>2. Kongbamchandramanisingh, "Basic Physics", PHI, 2018.</li> <li>3. M.N.Avathanalu, P.G.Kshirsagar "A text book of engineering physics" S.Chand &amp; company Ltd, 2017.</li> </ol>	
<b>WEB LINKS</b>	
<ol style="list-style-type: none"> <li>1. <a href="https://bayanbox.ir/view/7764531208313247331/Kleppner-D.-Kolenkow-R.J.-Introduction-to-Mechanics-2014.pdf">https://bayanbox.ir/view/7764531208313247331/Kleppner-D.-Kolenkow-R.J.-Introduction-to-Mechanics-2014.pdf</a>.</li> <li>2. <a href="https://physicaeducator.files.wordpress.com/2017/11/electricity_and_magnetism-by-purcell-3ed-ed.pdf">https://physicaeducator.files.wordpress.com/2017/11/electricity_and_magnetism-by-purcell-3ed-ed.pdf</a>.</li> <li>3. <a href="https://rajeshvcet.home.blog/regulation-2021/ph3151-engineering-physics-study-materials/">https://rajeshvcet.home.blog/regulation-2021/ph3151-engineering-physics-study-materials/</a></li> <li>4. <a href="https://zenodo.org/record/243407#.ZEgPZXZBzIU">https://zenodo.org/record/243407#.ZEgPZXZBzIU</a></li> <li>5. <a href="https://farside.ph.utexas.edu/teaching/qmech/qmech.pdf">https://farside.ph.utexas.edu/teaching/qmech/qmech.pdf</a> <a href="https://web.pdx.edu/~pmoock/phy381/workbook%20nanoscience.pdf">https://web.pdx.edu/~pmoock/phy381/workbook%20nanoscience.pdf</a></li> </ol>	

<b>Mapping of COs with POs / PSOs</b>														
<b>COs</b>	<b>POs</b>												<b>PSOs</b>	
	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>	<b>11</b>	<b>12</b>	<b>1</b>	<b>2</b>
<b>1</b>	3	3	3	-	-	-	-	-	1	1	-	2	-	-
<b>2</b>	3	2	3	-	-	-	-	-	1	1	-	1	-	-
<b>3</b>	3	2	3	-	-	-	-	-	1	1	-	1	-	-
<b>4</b>	2	2	2	-	-	-	-	-	-	-	-	1	-	-
<b>5</b>	2	1	2	-	-	-	-	-	1	1	-	2	-	-
<b>CO (W.A)</b>	<b>2.6</b>	<b>2.0</b>	<b>2.6</b>	-	-	-	-	-	<b>1.0</b>	<b>1.0</b>	<b>0.0</b>	<b>1.0</b>	-	-

*Dr. N. S. S. S. S.*

## 22CYB08 - ENVIRONMENT AND SUSTAINABILITY

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

**PRE REQUISITE : NIL**

Course Objectives		Course Outcomes	
<b>1.0</b>	To recognize the basic concepts of environment, ecosystems and biodiversity.	<b>1.1</b>	The students will be able to know the importance of environment and functions ecosystems and biodiversity
<b>2.0</b>	To impart knowledge on the causes, effects and control measures of environmental pollution.	<b>2.1</b>	The students will be able to identify the causes, effects of environmental pollution and contribute the preventive measures to the society.
<b>3.0</b>	To make the students conversant with the global and Indian scenario of renewable resources, causes of their degradation and measures to preserve them.	<b>3.1</b>	The students will be able to identify and understand the renewable and non-renewable resources and contribute to the sustainable measures to preserve them for future generations.
<b>4.0</b>	To familiarize the concept of sustainable development goals, recognize and analyze climate changes, concept of carbon credit and the challenges of environmental management.	<b>4.1</b>	The students will be able to recognize the different goals of sustainable development and apply them for suitable technological advancement and societal development.
<b>5.0</b>	To inculcate and embrace sustainability practices and develop a broader understanding on green materials, energy cycles and analyzes the role of sustainable urbanization.	<b>5.1</b>	The students will be able to demonstrate the sustainability practices and identify green materials, energy cycles.

<b>UNIT I - ENVIRONMENT AND BIODIVERSITY</b>	<b>(6)</b>
Environment - scope and importance - Eco-system: Structure and function of an ecosystem - types of biodiversity - genetic - species and ecosystem diversity - values of biodiversity - hot-spots of biodiversity - conservation of biodiversity: In-situ and ex-situ.	
<b>UNIT II - ENVIRONMENTAL POLLUTION</b>	<b>(6)</b>
Pollution - Causes - Effects and Preventive measures of Water, Air and noise pollution - Solid waste management: methods of disposal of solid waste - Environmental protection act: Air act - Water act.	
<b>UNIT III - RENEWABLE SOURCES OF ENERGY</b>	<b>(6)</b>
Energy management and conservation - New Energy Sources: Different types of new energy sources - Solar energy - wind energy - Applications of Hydrogen energy, Ocean energy resources, Tidal energy conversion.	
<b>UNIT IV - SUSTAINABILITY AND MANAGEMENT</b>	<b>(6)</b>
Development - Factors affecting development - advantages - disadvantages - GDP - Sustainability - needs - concept - concept of carbon credit - carbon footprint - Environmental management.	
<b>UNIT V - SUSTAINABILITY PRACTICES</b>	<b>(6)</b>
Zero waste and R concept - ISO 14000 Series - Environmental Impact Assessment - Sustainable energy: Energy Cycles- carbon cycle and carbon emission - Green Engineering: Sustainable urbanization.	
<b>TOTAL (L:30) : 30 PERIODS</b>	

**TEXT BOOKS:**

1. Dr. A.Ravikrishan, "Environmental Science and Engineering", Sri Krishna Hitech Publishing co. Pvt.Ltd., Chennai, 15th Edition, 2023.
2. Anubha Kaushik and C. P. Kaushik's "Perspectives in Environmental Studies", 6th Edition, New Age International Publishers, 2018.

**REFERENCES:**

1. Rajagopalan, R, "Environmental Studies-From Crisis to Cure", Oxford University Press, Third Edition, 2015.
2. Erach Bharucha, "Textbook of Environmental Studies for Undergraduate Courses" Orient Blackswan Pvt. Ltd. 2013.

**WEBLINK:**

1. <http://www.jnkvv.org/PDF/08042020215128Amit1.pdf>
2. <https://www.conserve-energy-future.com/types-of-renewable-sources-of-energy.php>
3. <https://ugreen.io/sustainability-engineering-addressing-environmental-social-and-economic-issues/>

Mapping of COs with POs / PSOs														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	2	2	2			3	3	2	1			2		
2	2	2	2			3	3	2	1			2		
3	2	2	2			3	3	2	1			2		
4	2	2	2			3	3	2	1			2		
5	2	2	2			3	3	2	1			2		
<b>CO (W.A)</b>	<b>2</b>	<b>2</b>	<b>2</b>			<b>3</b>	<b>3</b>	<b>2</b>	<b>1</b>			<b>2</b>		



- Approved by Eleventh Academic Council

**22PYP01 - PHYSICS LABORATORY  
(Common to All Branches)**

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>

**PRE REQUISITE : NIL**

<b>Course Objectives</b>		<b>Course Outcomes</b>	
1.0	To provide the basic practical exposure to all the engineering and technological streams in the field of physics.	1.1	Students will be able to apply the concept of stress, strain and elastic limit for a given sample to find their properties
2.0	To infer the practical knowledge by applying the experimental methods to correlate with the Physics theory.	2.1	Students will be able to gain the basic knowledge about handling the laser light and Identify the basic parameters of an optical fibre
3.0	To enable the students to correlate the theoretical principles with application oriented studies.	3.1	Students will be able to analyze the properties of matter with sound waves
4.0	To introduce different experiments to test basic understanding of physics concepts applied in optics and electronics	4.1	Students will be able to recall the knowledge of properties of light through spectrometer grating and fiber optic cable
5.0	To analyze the behavior and characteristics of solar cells and LED	5.1	Students will be able to acquire the knowledge in semiconducting devices such as solar cells and LED

**Physics Laboratory**

1. Determination of Young's modulus by non-uniform bending method
2. Determination of (a) wavelength and (b) particle size using Laser.
3. Determination of thermal conductivity of a bad conductor – Lee's Disc method.
4. Determination of wavelength of mercury spectrum – spectrometer grating
5. Determination of band gap of a semiconductor.
6. Determination of thickness of a thin wire – Air wedge method.
7. Determination of V-I characteristics of solar cell.

**TOTAL (P:30) : 30 PERIODS**



Mapping of COs with POs / PSOs														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	3	3	-	-	-	-	-	-	1	-	2	1	-
2	3	3	2	-	-	-	-	-	-	-	-	1	1	-
3	3	3	2	-	-	-	-	-	1	-	-	1	-	-
4	3	2	3	-	-	-	-	-	-	-	-	2	-	-
5	3	2	2	-	-	-	-	-	-	1	-	1	-	-
<b>CO (W.A)</b>	<b>3.0</b>	<b>2.0</b>	<b>2.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>1.0</b>	<b>1.0</b>	<b>0.0</b>	<b>1.0</b>	<b>0.0</b>

*Signature*

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**22GYA01 HERITAGE OF TAMILS**  
(For Common To All Branches)

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>1</b>	<b>0</b>	<b>0</b>	<b>1</b>

**PRE REQUISITE : NIL**

**UNIT I - LANGUAGE AND LITERATURE**

**(3)**

Language Families in India - Dravidian Languages – Tamil as a Classical Language - Classical Literature in Tamil – Secular Nature of Sangam Literature – Distributive Justice in Sangam Literature - Management Principles in Thirukural - Tamil Epics and Impact of Buddhism & Jainism in Tamil Land - Bakthi Literature Azhwars and Nayanmars - Forms of minor Poetry - Development of Modern literature in Tamil - Contribution of Bharathiyar and Bharathidhasan.

**UNIT II - HERITAGE - ROCK ART PAINTINGS TO MODERN ART - SCULPTURE**

**(3)**

Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making - Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments - Mridhangam, Parai, Veenai, Yash and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils.

**UNIT III - FOLK AND MARTIAL ARTS**

**(3)**

Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyilattam, Leatherpuppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.

**UNIT IV - THINAI CONCEPT OF TAMILS**

**(3)**

Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature - Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas.

**UNIT V - CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE**

**(3)**

Contribution of Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books.

**TOTAL (L:15) : 15 PERIODS**

**TEXT-CUM-REFERENCE BOOKS**

1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே.பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் – முனைவர் இல.சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருளுத – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)

5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies).
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

**22GYA02 TAMILS AND TECHNOLOGY**  
(For Common To All Branches)

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>1</b>	<b>0</b>	<b>0</b>	<b>1</b>

**PRE REQUISITE : NIL**

**UNIT I - WEAVING AND CERAMIC TECHNOLOGY**

**(3)**

Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries.

**UNIT II - DESIGN AND CONSTRUCTION TECHNOLOGY**

**(3)**

Designing and Structural construction House & Designs n household materials during Sangam Age - Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram - Sculptures and Temples of Mamallapuram - Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple)- Thirumalai Nayakar Mahal - Chetti Nadu Houses, Indo - Saracenic architecture at Madras during British Period.

**UNIT III - MANUFACTURING TECHNOLOGY**

**(3)**

Art of Ship Building - Metallurgical studies - Iron industry - Iron smelting, steel - Copper and gold- Coins as source of history - Minting of Coins – Beads making-industries Stone beads -Glass beads - Terracotta beads -Shell beads/ bone beads - Archeological evidences - Gem stone types described in Silappathikaram.

**UNIT IV - AGRICULTURE AND IRRIGATION TECHNOLOGY**

**(3)**

Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoempu of Chola Period, Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing - Knowledge of Sea - Fisheries – Pearl - Conche diving - Ancient Knowledge of Ocean - Knowledge Specific Society.

**UNIT V - SCIENTIFIC TAMIL & TAMIL COMPUTING**

**(3)**

Development of Scientific Tamil - Tamil computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project.

**TOTAL (L:15) : 15 PERIODS**

**TEXT-CUM-REFERENCE BOOKS**

1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே.பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் – முனைவர் இல.சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருளை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)

5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

**22MYB03 - STATISTICS AND NUMERICAL METHODS**  
(Common to Mechanical, Civil, Agriculture, Chemical Branches)

<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>3</b>	<b>1</b>	<b>0</b>	<b>4</b>

**PRE REQUISITE : NIL**

Course Objectives		Course Outcomes	
<b>1.0</b>	To acquaint the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems.	<b>1.1</b>	The students will be able to select a hypothesis testing method for the given numerical set of data to analyze the significance.
<b>2.0</b>	To understand the knowledge of design of experiments	<b>2.1</b>	The students will be able to apply analysis of Variance for the data set of selected number factors for analyzing the significance.
<b>3.0</b>	To introduce the basic concepts of solving algebraic and transcendental equations.	<b>3.1</b>	The students will be able to solve an algebraic or transcendental equation using an appropriate numerical method.
<b>4.0</b>	To introduce the numerical techniques of interpolation in various intervals and numerical techniques of differentiation and integration which plays an important role in Engineering and technology disciplines.	<b>4.1</b>	The students will be able to appreciate the numerical techniques of interpolation in various intervals and apply the numerical techniques of differentiation and integration for Engineering problems.
<b>5.0</b>	To acquaint the knowledge of various techniques and methods of solving ordinary differential equations.	<b>5.1</b>	The students will be able to solve the partial and ordinary differential equations with initial and boundary conditions by using certain techniques with Engineering applications.

**UNIT I - TESTING OF HYPOTHESIS**

**(9+3)**

Sampling Distributions-Tests for single mean, difference of means (Large and Small samples) Using z, t - distribution, F - distribution- Chi-square - Test for independence of attributes and Goodness of fit.

**UNIT II - DESIGN OF EXPERIMENTS**

**(9+3)**

Analysis of variance - Completely randomized design - Randomized block design - Latin square design.

**UNIT III - SOLUTION OF EQUATIONS AND EIGEN VALUE PROBLEMS**

**(9+3)**

Solution of algebraic and transcendental equations - Fixed point iteration method - Newton Raphson method- Solution of linear system of equations Gauss elimination method – Iterative methods of Gauss Jacobi and Gauss Seidel Methods- Eigen values of a matrix by Power method.

**UNIT IV - INTERPOLATION AND APPROXIMATION**

**(9+3)**

Lagrange's and Newton's divided difference interpolations - Newton's forward and backward difference interpolation - Numerical single and double integrations using Trapezoidal and Simpson's 1/3 rules - Romberg's Methods.

**UNIT V - NUMERICAL DIFFERENTIATION AND INTEGRATION**

**(9+3)**

Single step methods: Taylor's series method - Euler's method - Modified Euler's method - Fourth order Runge - Kutta method for solving first order differential equations - Multi step methods: Milne's and Adams - Bash forth predictor corrector methods for solving first order differential equations.

**TOTAL (L:45+T:15) : 60 PERIODS**

<b>TEXT BOOKS:</b>
<ol style="list-style-type: none"> <li>1. Grewal, B.S., and Grewal, J.S., "Numerical Methods in Engineering and Science", Khanna Publishers, 10th Edition, New Delhi, 2015.</li> <li>2. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.</li> <li>3. Gupta S.C. and Kapoor V. K., "Fundamentals of Mathematical Statistics", Sultan Chand &amp; Sons, New Delhi, 12<sup>th</sup> Edition, 2020.</li> </ol>
<b>REFERENCES:</b>
<ol style="list-style-type: none"> <li>1. Burden, R.L and Faires, J.D, "Numerical Analysis", 9th Edition, Cengage Learning, 2016.</li> <li>2. Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8th Edition, 2014.</li> <li>3. Gerald. C.F. and Wheatley. P.O. "Applied Numerical Analysis" Pearson Education, Asia, New Delhi, 7<sup>th</sup> Edition, 2007.</li> </ol>
<b>WEB REFERENCES:</b>
<ol style="list-style-type: none"> <li>1. <a href="https://youtu.be/zmyh7nCjmsg">https://youtu.be/zmyh7nCjmsg</a></li> <li>2. <a href="https://youtu.be/NmgbFj4UwPs">https://youtu.be/NmgbFj4UwPs</a></li> <li>3. <a href="https://youtu.be/RgKy7URFxlC">https://youtu.be/RgKy7URFxlC</a></li> <li>4. <a href="https://archive.nptel.ac.in/courses/111/107/111107105/">https://archive.nptel.ac.in/courses/111/107/111107105/</a></li> </ol>

Mapping of COs with POs / PSOs														
COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	3	3	1	1	1				1			2		
2	3	3	1	1	1				1			2		
3	3	2	1	1	1				1			2		
4	3	3	1	1	1				1			2		
5	3	2	1	1	1				1			2		
<b>CO (W.A)</b>	<b>3</b>	<b>3</b>	<b>1</b>	<b>1</b>	<b>1</b>				<b>1</b>			<b>2</b>		

*Dr. Anil Kumar*

<b>22CEC05 - CONSTRUCTION MATERIALS AND PRACTICES</b>					
		<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>2</b>	<b>4</b>
<b>PREREQUISITE : NIL</b>					
<b>Course Objectives</b>			<b>Course Outcomes</b>		
<b>1.0</b>	To gain knowledge about the various materials used for the construction work.	<b>1.1</b>	The students will be able to identify the role of bricks, stones, cement and rocks in construction.		
<b>2.0</b>	To study the basic properties of concrete and steel.	<b>2.1</b>	The students will be able to infer the properties of concrete and steel as construction materials.		
<b>3.0</b>	To get idea on the market forms of mortar , timber, steel	<b>3.1</b>	The students will be able to identify the usage of modern materials used in buildings.		
<b>4.0</b>	To imparts knowledge on the construction and the construction techniques	<b>4.1</b>	The students will be able to interpret the various construction practices and techniques adopted in building construction.		
<b>5.0</b>	To know the types of floors and roofs, plastering, damp proof courses and various support structures adopted in building construction.	<b>5.1</b>	The students will be able to select various equipment's for construction works conditioning of building		

<b>UNIT I - BUILDING MATERIALS</b>	<b>(9)</b>
Introduction and types of building materials - Properties - Physical and mechanical properties. Stones and Rocks: Classification of Rocks - Qualities of good stones - Uses. Bricks: Constituents - Qualities of good brick - Classification - Uses. Cement: Ingredients - Qualities of good cement - Types and Uses of cement.	
<b>UNIT II - MORTAR, CONCRETE AND STEEL</b>	<b>(9)</b>
Mortar: Types of Mortars - Properties - Uses - Selection of mortar. Concrete: Ingredients - Types of Concrete - Properties - Uses - Reinforced concrete. Steel: Steel sections - steel as a reinforcing material - Types of reinforcing steels.	
<b>UNIT III - OTHER MATERIALS</b>	<b>(9)</b>
Timber: Characteristics of timber - Seasoning of timber - Properties and uses - Common forms of timber - Plywood - Veneer - False ceiling materials - Aluminum - Uses - Market forms - Glass - Ceramics - Refractories - Composite Materials - Types and applications - FRP - Fibre textiles - Geomembranes and Geotextiles for earth reinforcement.	
<b>UNIT IV - CONSTRUCTION PRACTICES AND SERVICE REQUIREMENTS</b>	<b>(9)</b>
Types of Foundations - Shallow and Deep Foundations - Stone Masonry - Brick Masonry - Plastering and Pointing - Cavity Walls - Diaphragm Walls - Formwork - Centering and Shuttering - Shoring - Scaffolding - Underpinning - Roofing - Flooring - Joints in concrete - Contraction/Construction/Expansion joints - Fire Protection - Thermal Insulation - Ventilation and Air conditioning - Acoustics and Sound Insulation - Damp Proofing.	



**UNIT V - CONSTRUCTION EQUIPMENTS****(9)**

Selection of equipment for earthwork excavation, concreting, material handling and erection of structures - Dewatering and pumping equipment.

**LIST OF EXPERIMENTS:**

1. Determination of Tension on mild steel rod.
2. Determination of Compression strength on Bricks and Blocks.
3. Determination of Water Absorption Test on Bricks and Blocks.
4. Determination of Izod and Charpy impact test on metal specimens.
5. Finding out the Rockwell Hardness Number on metal Specimens.
6. Finding out the Brinell hardness test on metal Specimens.
7. Determination of Torsional strength of steel specimen.

**TOTAL (L:45+P:30) = 75 PERIODS****TEXTBOOK:**

1. Palanichamy M.S., "Basic Civil Engineering", 4th Edition, McGraw-Hill Education, New Delhi, 2020.

**REFERENCES:**

1. Navaneethakrishnan P., "Basic of Civil and Mechanical Engineering", 1st Edition, McGraw-Hill Education, New Delhi, 2016
2. Duggal S.K., "Building Materials", 5th Edition, New Age Publishers, 2021.

**Mapping of COs with POs / PSOs**

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
<b>1</b>	2	-	2	-	-	-	-	2	-	-	-	2	3	-
<b>2</b>	2	-	2	-	-	-	2	2	-	2	-	2	3	-
<b>3</b>	2	-	-	--	-	-	2	2	-	-	-	2	2	2
<b>4</b>	2	-	3	-	-	-	-	-	-	2	-	2	2	2
<b>5</b>	2	-	2	-	2	-	-	-	-	-	-	2	-	2
<b>CO (W.A)</b>	2	-	2.3	-	2	-	2	2	-	2	-	2	2.5	2



22CEP03 - COMPUTER AIDED BUILDING DRAWING - II					
		<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>0</b>	<b>0</b>	<b>4</b>	<b>2</b>
<b>PREREQUISITE : NIL</b>					
Course Objectives		Course Outcomes			
<b>1.0</b>	To impart knowledge and skill relevant to Building drawing and Detailing lab using computer software.	<b>1.1</b>	The students will be able to select the various basic commands used for drafting and know the types of coordinate.		
<b>2.0</b>	To make the students learn the various elements of Residential buildings.	<b>2.1</b>	The students will be able to sketch the detailed drawings of plan, elevation and section of a multi storey residential building		
<b>3.0</b>	To impart a thorough knowledge on the computer aided analysis and design of structural components.	<b>3.1</b>	The students will be able to prepare a approval plan.		
<b>4.0</b>	To study the different types of buildings and their views.	<b>4.1</b>	The students will be able to prepare plan, section and elevation for industrial building.		
<b>5.0</b>	To impart fundamental knowledge on AutoCAD to make the students draw the structures, the plan, elevation and sectional view of a building.	<b>5.1</b>	The students will be able to draw the plan, elevation and sectional view of the commercial building.		

#### LIST OF EXPERIMENTS:

1. Draw the Plan, Elevation and Section of an Industrial Building
2. Draw the Plan, Elevation and Section of a School Building with Framed structure
3. Draw the multi-Storied residential building with Dog legged staircase - Plan, Section and Elevation
4. Draw a Primary Health Center- Plan, Section and Elevation
5. Draw a Industrial building - Plan, Section and Elevation
6. Draw a Hostel Building - Plan, Section and Elevation
7. Draw a plan for Shopping Mall
8. Draw a Plan for Apartment Building
9. Layout Preparation for Individual Villas
10. Preparation of approval plan for a Commercial Building
11. 3D view for Residential Building

**TOTAL (P:60) = 60 PERIODS**

**REFERENCES/ MANUAL /SOFTWARE:**

1. Reference manual for AutoCAD
2. Sikka V.B., "A course in Civil Engineering Drawing", 4th Edition, S.K.Kataria and Sons, 2015.
3. Bhavikatti, S.S and Chitawadagi, M.V., "Building Planning and Drawing", I.K. International Publishing House Pvt.Ltd. New Delhi,2019

Mapping of COs with POs / PSOs														
Cos	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
1	2	-	2	3	3	-	-	-	3	3	-	3	3	3
2	2	-	2	3	3	2	-	2	3	3	3	3	3	3
3	3	-	3	3	3	3	-	-	3	3	3	3	3	3
4	2	-	2	2	3	2	-	2	2	3	3	3	3	3
5	3	2	2	3	3	2	-	2	3	3	3	3	3	3
CO (W.A)	2.4	2	2.2	2.8	3	2.3	-	2	2.8	3	3	3	3	3



# NANDHA ENGINEERING COLLEGE

## (Autonomous)

Affiliated to Anna University Chennai + Approved by AICTE + Accredited by NAAC (A+ Grade)

Pitchandampalayam (P.O), Vaikkalmedu, Erode - Perundurai Road, Erode - 638 052

Phone : 04294 - 225585, 223711, 223722, 226393 Mobile : 73737 23722 Fax : 04294 - 224787

Website : [www.nandhaengg.org](http://www.nandhaengg.org)

E.mail : [info@nandhaengg.org](mailto:info@nandhaengg.org)

### Details of Courses Where Syllabus was carried out in

#### M.E Structural Engineering (R22)

S.No	Course Code	Course Name	% of change
1.	22STA01	Advanced Mathematics for Structural Engineering	30
2.	22STB06	Finite Element Analysis in Structural Engineering	30
3.	22STB07	Design of Substructures	20
4.	22STP02	Advanced Computer Aided Structural Analysis Laboratory	50
5.	22STE01	Practical Training	100
6.	22PGA01	English for Research Paper Writing	100
7.	22PGA02	Disaster Management	100
8.	22PGA03	Constitution of India	100
9.	22STX02	Experimental Techniques and Analysis	20
10.	22STX03	Soil - Structure Interaction	30
11.	22STX04	Prefabricated Structures	30
12.	22STX06	Design of Plates and Shells	20
13.	22STX09	Maintenance and Rehabilitation of Structures	20
14.	22STX17	Structural Health Monitoring	100
15.	22STX19	Design of Formwork	100
16.	22STX20	Green Building Management	100
17.	22STX21	Risk and Reliability Structures	100
18.	22STX22	Design of Steel Concrete Composite Structures	100
Average			63.89%



**PRINCIPAL**

Nandha Engineering College  
(Autonomous)  
Erode - 638 052.

22STA01- ADVANCED MATHEMATICS FOR STRUCTURAL ENGINEERING					
		<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>PRE REQUISITE : NIL</b>					
Course Objectives		Course Outcomes			
<b>1.0</b>	To acquire knowledge on random variable and moments & moments generating functions	<b>1.1</b>	The students will be able to infer expectation, variance, standard deviation moments and moment generating function for discrete and continuous random variables.		
<b>2.0</b>	To gain knowledge on calculus of variance.	<b>2.1</b>	The students will be able to solve problems involving functional, that occurs in various branches of engineering disciplines.		
<b>3.0</b>	To comprehend the concepts of parameter estimation.	<b>3.1</b>	The students will be able to use a sample data to compute point estimate.		
<b>4.0</b>	To evaluate mathematical expressions to compute quantities that deal with linear systems and eigenvalue problems	<b>4.1</b>	The students will be able to understand the concept of eigen value problems		
<b>5.0</b>	To introduce numerical solution methods for solving partial differential equations	<b>5.1</b>	The students will be able to solve elliptic partial differential equations by using finite difference methods.		
<b>UNIT I - PROBABILITY AND RANDOM VARIABLES</b>					<b>(9)</b>
Random variables - Probability mass function - Probability density function - Properties - Moments - Moment generating functions.					
<b>UNIT II - CALCULUS OF VARIATIONS</b>					<b>(9)</b>
Calculus of Variations: Concept of variation and its properties - Euler's equation - Functional dependent on first and higher order derivatives - Functional dependent on functions of several independent variables - Direct methods : Ritz and Kantorovich methods.					
<b>UNIT III - PARAMETER ESTIMATION</b>					<b>(9)</b>
Point Estimation - Characteristics of estimators - Unbiasedness - Consistency - Efficiency - Sufficiency - Methods of point estimation - Method of moments.					
<b>UNIT IV - EIGEN VALUE PROBLEMS</b>					<b>(9)</b>
Methods of solutions: Faddeev - Leverrier Method & Power Method with deflation - Approximate Methods: Rayleigh - Ritz method.					
<b>UNIT V - NUMERICAL SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS</b>					<b>(9)</b>
Numerical Solution of Partial Differential Equations: Solution of one dimensional wave equation - Explicit and implicit methods (Crank-Nicolson, Bender Schmidt methods) - Solution of Elliptic equation: Solution of Laplace equation (Liebmann's iteration process).					
<b>TOTAL (L:45) : 45 PERIODS</b>					

**REFERENCES:**

1. Richard A. Johnson and Miller & Freund's, "Probability and Statistics for Engineers", 8th Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2010.
2. Gupta, A.S., "Calculus of Variations with Applications", Prentice Hall of India Pvt. Ltd., New Delhi, 1997.
3. Smith, G. D., "Numerical Solutions of Partial Differential Equations: Finite Difference Methods", 3rd Edition, Clarendon Press, 1985.
4. Sankara Rao K, "Introduction to Partial Differential Equations", PHI Learning Pvt. Ltd, 3<sup>rd</sup> ed., 2011.
5. Curtis F. Gerald, Patrick O. Wheatley, "Applied Numerical Analysis", 7th Edition, Pearson Education India, 2007.
6. Richard I. Levin, H. Siddiqui Masood, David S. Rubin, Rastogi Sanjay, "Statistics for Management", Pearson Education, 8<sup>th</sup> ed., 2017.

**Mapping of COs with POs / PSOs**

COs	POs						PSOs	
	1	2	3	4	5	6	1	2
1	3		2	3	2	1		1
2	3		1	2	1		2	
3	3	2		1		2		2
4	3		2	2	1	2	1	1
5	3		2	1	2	2	1	2
<b>CO (W.A)</b>	<b>3</b>	<b>2</b>	<b>1.75</b>	<b>1.8</b>	<b>1.5</b>	<b>1.75</b>	<b>1.33</b>	<b>1.5</b>





22STB06 - FINITE ELEMENT ANALYSIS IN STRUCTURAL ENGINEERING				
		<b>L</b>	<b>T</b>	<b>P</b>
		<b>3</b>	<b>1</b>	<b>0</b>
<b>PRE REQUISITE : NIL</b>				
Course Objectives		Course Outcomes		
<b>1.0</b>	To impart fundamental knowledge on the finite element method and its applications	<b>1.1</b>	The student will be able to demonstrate the concept of finite element analysis and approximate solutions, techniques	
<b>2.0</b>	To gain knowledge on one dimensional structural engineering problems	<b>2.1</b>	The student will be able to execute finite element analysis concept in one dimensional element problems	
<b>3.0</b>	To Acquire knowledge about the finite element analysis of 2-D and 3-D problems	<b>3.1</b>	The student will be able to apply the finite element analysis concept in two and three dimensional element problems	
<b>4.0</b>	To understand the FEM analysis for framed structures Analyse the framed structures using FEM analysis	<b>4.1</b>	The student will be able to analyze the framed structures	
<b>5.0</b>	To study the applications of FEM	<b>5.1</b>	The student will be able to apply finite element analysis concept in nonlinear, vibration and thermal problems	
<b>UNIT I - INTRODUCTION</b>				<b>(9+3)</b>
Approximate solutions of boundary value problems-Methods of weighted residuals, approximate solution using variational method, Modified Galerkin method. Basic finite element concepts - Basic ideas in a finite element solution, General finite element solution procedure, Finite element equations using modified Galerkin method.				
<b>UNIT II - ONE DIMENSIONAL PROBLEMS</b>				<b>(9+3)</b>
One dimensional problems - Coordinate systems - global, local and natural coordinate systems, shape functions - Bar, beam and truss element - Generation of Stiffness Matrix and Load Vector.				
<b>UNIT III - TWO AND THREE DIMENSIONAL PROBLEMS</b>				<b>(9+3)</b>
Two Dimensional problems - Plane Stress, Plane Strain Problems -Triangular and Quadrilateral Elements - Isoparametric Formulation - Natural Coordinates, Shape function, stiffness matrix - Asymmetric Problems - Higher Order Elements -Numerical Integration - Three dimensional elasticity - Governing differential equations - Higher order Isoparametric solid elements				
<b>UNIT IV - ANALYSIS OF FRAMED STRUCTURES</b>				<b>(9+3)</b>
Stiffness of Truss Member - Analysis of Truss - Stiffness of Beam Member - Finite Element Analysis of Continuous Beam - Plane Frame Analysis - Numerical Evaluation of Element Stiffness - Formulation for 3 Dimensional Elements - Solution for simple frames				
<b>UNIT V - APPLICATIONS</b>				<b>(9+3)</b>
Finite Elements for Elastic Stability - Dynamic Analysis - Nonlinear, Vibration and Thermal Problems - Meshing and Solution Problems - Modeling and analysis using FEA software's.				
<b>TOTAL (L:45 ,T:15) : 60 PERIODS</b>				

**REFERENCES:**

1. S. S. Bhavikatti, "Finite Element Analysis", 4th Edition, New Age Publishers, 2005
2. Reddy. J.N., "An Introduction to the Finite Element Method", 3rd Edition, Tata McGraw-Hill, 2006
3. Seshu, P, "Text Book of Finite Element Analysis", Prentice - Hall of India Pvt. Ltd., New Delhi, 2004
4. Chandrupatla, R.T. and Belegundu, A.D., "Introduction to Finite Elements in Engineering", 4th Edition, Prentice Hall of India, 2015.
5. C. Krishnamoorthy, "Finite Element Analysis: Theory and Programming", Tata McGraw-Hill Education Pvt. Ltd., New Delhi, 2017.

**Mapping of COs with POs / PSOs**

COs	POs						PSOs	
	1	2	3	4	5	6	1	2
1	2		2	2			2	2
2			2	3		2		2
3	2		2	3	2	1	2	2
4		2		3	3	3	2	2
5	2		2		2		3	2
<b>CO (W.A)</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>2.75</b>	<b>2.33</b>	<b>2</b>	<b>2.25</b>	<b>2</b>





22STB07 - DESIGN OF SUBSTRUCTURES					
		<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>PRE REQUISITE : NIL</b>					
Course Objectives			Course Outcomes		
<b>1.0</b>	To understand the design aspects of shallow foundations	<b>1.1</b>	The student will be able to analyze and design different types of shallow and raft foundations		
<b>2.0</b>	To study about design of the pile foundations	<b>2.1</b>	The student will be able to calculate the load carrying capacity of the piles and pile group and design various types of piles		
<b>3.0</b>	To gain knowledge on the design methods of piers and caisson	<b>3.1</b>	The student will be able to design pier and caissons for tower, bridges and chimneys		
<b>4.0</b>	To study requirements and design criteria for the machine foundations	<b>4.1</b>	The student will be able to examine the structural aspects of machine foundation		
<b>5.0</b>	To learn about design concepts of the tunnels and conduits	<b>5.1</b>	The student will be able to explain the concept of tunnel and conduits construction		
<b>UNIT I - SHALLOW FOUNDATIONS</b>					<b>(9)</b>
Types of foundations and their specific applications - Depth of foundation - Bearing capacity and settlement estimates - Structural design of isolated - strip - rectangular - trapezoidal and combined footings - strap - raft foundation.					
<b>UNIT II - PILE FOUNDATIONS</b>					<b>(9)</b>
Types of piles and their applications - Load carrying capacity - Settlements - Group action - Design of piles and pile caps - Design of under reamed piles.					
<b>UNIT III - PIERS AND CAISSONS</b>					<b>(9)</b>
Drilled piers - construction - advantages and disadvantages - design and construction of open caissons - pneumatic caissons - floating caisson - piers and caissons for bridges - Foundations for towers, chimneys and silos.					
<b>UNIT IV - MACHINE FOUNDATIONS</b>					<b>(9)</b>
Types - General requirements and design criteria - vibration analysis of machine foundation - determination of natural frequency - foundation for reciprocating machine - vibration isolation and control.					
<b>UNIT V - TUNNEL AND CONDUITS</b>					<b>(9)</b>
Stresses in soil around tunnels - construction of earth tunnels - arching in soils - types of underground conduits - ditch, positive and negative projecting conduits - surface load on conduits - construction of conduits.					
<b>TOTAL (L:45) : 45 PERIODS</b>					

**REFERENCES:**

1. Nayak N.V., "Foundation Design Manual for Practicing Engineers", 2nd Edition, Dhanpatrai and Sons, 2012.
2. Braja M. Das, "Principles of Foundations Engineering", 8th Edition, Thomson Asia (P) Ltd., 2017
3. Megaw T.M. and Bartlett J.V., "Tunnels: planning, design, construction", 3rd Edition, John Wiley & Sons, Ellis Horwood, 1983.
4. Varghese. P.C, "Design of Reinforced Concrete foundations", PHI Learning Pvt.Ltd , 2009.

Mapping of COs with POs / PSOs								
COs	POs						PSOs	
	1	2	3	4	5	6	1	2
1	2	2	3	3	3	3	2	3
2	3	3	3	3	3	3	3	3
3	2	2	3	2	3	2	2	3
4		2	3	2	3	3	2	3
5	1		2	3	1	2	2	2
<b>CO (W.A)</b>	<b>2</b>	<b>2.25</b>	<b>2.8</b>	<b>2.6</b>	<b>2.6</b>	<b>2.6</b>	<b>2.2</b>	<b>2.8</b>

*S. V. Narayan Rao*

**22STP02 - ADVANCED COMPUTER AIDED STRUCTURAL ANALYSIS LABORATORY**

L	T	P	C
0	0	4	2

**PRE REQUISITE : 22STB02**

Course Objectives		Course Outcomes	
1.0	To acquire knowledge in the application of computer softwares for the analysis and design of structures	1.1	The student will be able to analyze and design different types of structures using software packages
2.0	To gain knowledge on design and detailing of various reinforced concrete and steel structures as per IS codal provisions using software	2.1	The student will be able to analyze and design the structure for various load combinations according to the relevant IS codes
3.0	To train the students in the application of programming for the analysis and design of structures	3.1	The student will be able to analyze the structures subjected to earthquake and wind forces

**LIST OF EXPERIMENTS**

1. Analysis and design of a single storey RCC building.
2. Analysis and design of Flat Slab
3. Analysis and design of a continuous beam.
4. Analysis and design of a continuous slab.
5. Analysis and Design of shear wall.
6. Analysis and Design of Foundation.
7. Analysis and Design of a 2D steel truss
8. Analysis and Design of Water tank.
9. Analysis and Design of Multi-storey RCC Building subjected to wind forces.
10. Analysis and Design of Multi-storey RCC Building subjected to seismic forces.

**TOTAL (P:60) : 60 PERIODS**

**REFERENCES:**

1. Unnikrishna Pillai and Devdas Menon, "Reinforced concrete Design", 3rd Edition, Tata McGraw Hill Publishers Company Ltd., New Delhi, 2006.
2. Subramanian N., "Design of Reinforced Concrete Structures", 1st Edition, Oxford University Press, 2014

Mapping of COs with POs / PSOs								
COs	POs						PSOs	
	1	2	3	4	5	6	1	2
1	2	3	2	3	3	2	2	3
2	2	2	3	3	2	2	3	3
3	3		3	3	3	3	3	3
<b>CO (W.A)</b>	<b>2.33</b>	<b>1.67</b>	<b>2.67</b>	<b>3</b>	<b>2.67</b>	<b>2.33</b>	<b>2.67</b>	<b>3</b>

*File - Netran araj*

**22STE01 - PRACTICAL TRAINING ( 4 Weeks)**

				L	T	P	C
				0	0	0	2
Course Objectives				Course Outcomes			
1.0	To get knowledge of practical problems related to structural engineering in carrying out engineering tasks.			1.1	The students will be able to participate in real-life construction projects		
2.0	To develop skills in facing and solving the field problems			2.1	The students will be able to put to use the theoretical knowledge gained		
3.0	To know about structural design and construction activities in practical			3.1	The students will be able to realize the various functions of construction activities and structural problems		

<b>SYLLABUS</b>	The students individually undertake training in reputed engineering companies doing Structural Engineering during the summer vacation for a specified duration of four weeks. At the end of training, a detailed report on the work done should be submitted within ten days from the commencement of the semester. The students will be evaluated through a viva-voce examination by a team of internal staff.	
<b>Evaluation</b>	<b>Component</b>	<b>Weightage</b>
	Mid semester presentation	25%
	Final presentation (Internal)	25%
	End Semester Training Report	30%
	Presentation	20%
	<b>Total</b>	<b>100%</b>

Mapping of COs with POs / PSOs								
COs	POs						PSOs	
	1	2	3	4	5	6	1	2
1	2		3		3	3	3	3
2	2		2		2	3	3	3
3	2		3	2	3	3	3	2
<b>CO (W.A)</b>	<b>2</b>		<b>2.67</b>	<b>2</b>	<b>2.67</b>	<b>3</b>	<b>3</b>	<b>2.67</b>

*Signature*

**22PGA01 ENGLISH FOR RESEARCH PAPER WRITING**

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

**PRE REQUISITE : NIL**

<b>Course Objectives</b>		<b>Course Outcomes</b>	
<b>1.0</b>	To make the students to improve writing skills and level of readability	<b>1.1</b>	The students will be able to improve writing skills and level of readability
<b>2.0</b>	To explain the strategic planning process and apply different presentation method	<b>2.1</b>	The students will be able to describe what to write in each section
<b>3.0</b>	To foster the ability to understand and to utilize the mechanics of writing	<b>3.1</b>	The students will be able to explain the skills needed for writing quality research paper
<b>4.0</b>	To Infer the skills needed when writing the Conclusion	<b>4.1</b>	The students will be able to explore the recent areas of research
<b>5.0</b>	To focus research and its key variables, guiding through research process	<b>5.1</b>	The students will be able to illustrate the good quality of paper at very first-time submission

<b>UNIT I - INTRODUCTION</b>	<b>(6)</b>
Planning and Preparation - Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness	
<b>UNIT II - PRESENTATION SKILLS</b>	<b>(6)</b>
Clarifying Who Did What- Highlighting Findings - Hedging and Criticizing- Paraphrasing - Sections of a Paper – Abstracts - Introduction	
<b>UNIT III - MECHANICS OF RESEARCH</b>	<b>(6)</b>
Key skills needed for writing - Title, Abstract, Introduction, Discussion, Conclusion, The Final Check	
<b>UNIT IV - PROCESS OF RESEARCH WRITING</b>	<b>(6)</b>
Skills needed for writing Methods - skills needed when writing Results - skills needed when writing Discussion - skills needed when writing Conclusion.	
<b>UNIT V - QUALITY RESEARCH PAPER</b>	<b>(6)</b>
Useful phrases, Checking Plagiarism – Bibliography – Citation - how to ensure paper is as good as it could possibly be the first- time submission	
<b>TOTAL (L:30) :30 PERIODS</b>	



**22PGA02 DISASTER MANAGEMENT**

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

**PRE REQUISITE : NIL**

<b>Course Objectives</b>		<b>Course Outcomes</b>	
<b>1.0</b>	To Summarize basics of disaster	<b>1.1</b>	The students will be able to summarize basics of disaster
<b>2.0</b>	To Explain a critical understanding of key concepts in disaster risk reduction and humanitarian response	<b>2.1</b>	The students will be able to explain a critical understanding of key concepts in disaster risk reduction and Humanitarian response.
<b>3.0</b>	To Illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.	<b>3.1</b>	The students will be able to illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
<b>4.0</b>	To Describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.	<b>4.1</b>	The students will be able to describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations
<b>5.0</b>	To Develop the strengths and weaknesses of disaster management approaches	<b>5.1</b>	The students will be able to develop the strengths and weaknesses of disaster management approaches

**UNIT I - INTRODUCTION****(6)**

Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

**UNIT II - REPERCUSSIONS OF DISASTERS AND HAZARDS****(6)**

Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.

**UNIT III - DISASTER PRONE AREAS IN INDIA****(6)**

Study of Seismic Zones; Areas Prone to Floods and Droughts, Landslides and Avalanches; Areas Prone to Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post-Disaster Diseases and Epidemics.

**UNIT IV - DISASTER PREPAREDNESS AND MANAGEMENT****(6)**

Preparedness: Monitoring of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological and Other Agencies, Media Reports: Governmental and Community Preparedness.



**UNIT V - RISK ASSESSMENT****(6)**

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival

**TOTAL (L:30) :30 PERIODS****REFERENCES:**

1. Goel S. L., Disaster Administration and Management Text and Case Studies", Deep & Deep Publication Pvt. Ltd., New Delhi, 2009.
2. Nishitha Rai, Singh AK, "Disaster Management in India: Perspectives, issues and strategies", 'New Royal book Company, 2007.
3. Sahni, PardeepEt.Al. ," Disaster Mitigation Experiences and Reflections", Prentice Hall of India, New Delhi, 2001.



**22PGA03 CONSTITUTION OF INDIA**

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

**PRE REQUISITE : NIL**

<b>Course Objectives</b>		<b>Course Outcomes</b>	
<b>1.0</b>	To understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.	<b>1.1</b>	Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
<b>2.0</b>	To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional	<b>2.1</b>	Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
<b>3.0</b>	To role and entitlement to civil and economic rights as well as the emergence nation hood in the early years of Indian nationalism.	<b>3.1</b>	Discuss the circumstances surrounding the foundation of the Congress Socialist Party[CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution..
<b>4.0</b>	To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.	<b>4.1</b>	Discuss the passage of the Hindu Code Bill of 1956.
<b>1.0</b>	To understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.	<b>1.1</b>	Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.

**UNIT I - HISTORY OF MAKING OF THE INDIAN CONSTITUTION****(6)**

History, Drafting Committee, (Composition &amp; Working)

**UNIT II - PHILOSOPHY OF THE INDIAN CONSTITUTION****(6)**

Preamble, Salient Features

**UNIT III- ONTOURS OF CONSTITUTIONAL RIGHTS AND DUTIES****(6)**

Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

**UNIT IV - LOCAL ADMINISTRATION****(6)**

District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO, Municipal Corporation. Pachayati raj: Introduction, PRI: Zila Pachayat. Elected officials and their roles, CEO Zila Pachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy.

**UNIT V- ELECTION COMMISSION****(6)**

Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners - Institute and Bodies for the welfare of SC/ST/OBC and women.

**TOTAL (L:30) :30 PERIODS****REFERENCES:**

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr.S.N.Busi, Dr.B. R.Ambedkar, "Framing of Indian Constitution", 1st Edition, 2015.
3. M.P. Jain, "Indian Constitution Law", 7th Edition, Lexis Nexis, 2014.
4. D.D. Basu, "Introduction to the Constitution of India", Lexis Nexis, 2015.



22STX02 - EXPERIMENTAL TECHNIQUES AND ANALYSIS					
		<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>PRE REQUISITE : NIL</b>					
<b>Course Objectives</b>			<b>Course Outcomes</b>		
<b>1.0</b>	To study about the measurements and performance of strains.	<b>1.1</b>	The students will be able to evaluate the measurement system of strains in structural elements		
<b>2.0</b>	To learn about the characteristics of structural vibrations measurements.	<b>2.1</b>	The students will be able to assess the different measurement method of vibrations		
<b>3.0</b>	To gain knowledge about the non-destructive structures testing and wind flow measurements	<b>3.1</b>	The students will be able to demonstrate on various testing methods and technologies.		
<b>4.0</b>	To understand the concepts of distress measurements and control	<b>4.1</b>	The students will be able to analyse the construction and damage assessment of RC Structures		
<b>5.0</b>	To apply the non destructive testing on various structures and elements.	<b>5.1</b>	The students will be able to determine strength by using NDT testing		
<b>UNIT I - STRAIN MEASUREMENTS</b>					<b>(9)</b>
Methods of measurements-Errors in measurements - Calibration of Testing Machines - Strain gauge, Principle, types, performance and uses. Photo elasticity - principle and applications - Hydraulic jacks and pressure gauges - Electronic load cells - Proving Rings.					
<b>UNIT II - VIBRATION MEASUREMENTS</b>					<b>(9)</b>
Characteristics of Structural Vibrations - Linear Variable Differential Transformer (LVDT) - Transducers for velocity and acceleration measurements. Vibration meter - Seismographs - Vibration Analyzer - Display and recording of signals - Cathode Ray Oscilloscope - XY Plotter - Chart Plotters - Digital data Acquisition systems.					
<b>UNIT III - ACOUSTICS AND WIND FLOW MEASURES</b>					<b>(9)</b>
Principles of pressure and flow measurements - pressure transducers - sound level meter - venturimeter - flow meters - wind tunnels and its uses in structural analysis - structural modeling - direct and indirect analysis.					
<b>UNIT IV - DISTRESS MEASUREMENTS AND CONTROL</b>					<b>(9)</b>
Diagnosis of distress in structures - crack observation and measurements - corrosion of reinforcement in concrete - Half cell, construction and use - damage assessment - controlled blasting for demolition - Techniques for residual stress measurements					
<b>UNIT V NON DESTRUCTIVE TESTING METHODS</b>					<b>(9)</b>
Load testing on structures, buildings, bridges and towers - Rebound Hammer - acoustic emission - ultrasonic testing principles and application - Holography - use of laser for structural testing - Brittle coating, Advanced NDT methods - Ultrasonic pulse echo, Impact echo, impulse radar techniques, GECOR & GPR.					

**REFERENCES:**

1. Sadhu Singh, "Experimental Stress Analysis", Khanna Publishers, 4th Edition, New Delhi, 2006.
2. Jindal U C ., "Experimental stress analysis", Pearson, New Delhi, 2013
3. Srinath.L.S, Raghavan.M.R, ingaiah.K, Gargasha.G, Pant.B and Ramachandra.K, "Experimental Stress Analysis", Tata McGraw Hill Company, New Delhi, 1984.
5. C. S. Rangan, "Instrumentation - Devices and Systems", Tata McGraw-Hill Publishing Co. Ltd., New Delhi, 1983

**Mapping of COs with POs / PSOs**

COs	POs						PSOs	
	1	2	3	4	5	6	1	2
1	2		2	2		2	2	3
2	2	1	3	2		2		2
3	2		2		2	2	3	2
4	3			3		2	2	
5			2			2		3
<b>CO (W.A)</b>	<b>1.8</b>	<b>1</b>	<b>2.25</b>	<b>2.33</b>	<b>2</b>	<b>2</b>	<b>2.33</b>	<b>2.5</b>



22STX03 - SOIL STRUCTURE INTERACTION					
		<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>PRE REQUISITE : NIL</b>					
Course Objectives			Course Outcomes		
<b>1.0</b>	To enable the students to learn the basics of soil-structure interactions.	<b>1.1</b>	The students will be able to illustrate the overview of soil-structure interactions		
<b>2.0</b>	To understand the relevance and significance of soil-structure interaction in the different cases of shallow foundation	<b>2.1</b>	The students will be able to analyze soil structure interaction problems in shallow foundation		
<b>3.0</b>	To analysis beams on elastic foundation -soil models.	<b>3.1</b>	The students will be able to demonstrate different types of soil structure models		
<b>4.0</b>	To acquire about the elastic analysis of piles and pile groups on the behavior of a structure.	<b>4.1</b>	The students will be able to investigate soil structure interaction parameters involved in the pile foundation		
<b>5.0</b>	To know the effects of soil-structure interactions in retaining structures.	<b>5.1</b>	The students will be able to analyze the soil structure interaction involved in retaining structures		

<b>UNIT I - INTRODUCTION TO SSI</b>	<b>(9)</b>
Introduction to SSI - Importance of SSI - Applications and Examples of SSI for geotechnical engineer- Effect of structure roughness / smoothness on soil behavior.	
<b>UNIT II - SSI IN SHALLOW FOUNDATION</b>	<b>(9)</b>
General soil-structure interaction problems - Shallow foundation, Sheet piles, Mat/Raft foundation, etc., Contact pressure and soil - structure interaction for shallow foundation, Fixed / Flexible base, Differential foundation settlement for high rise buildings - Pressure - settlement prediction from constitutive laws.	
<b>UNIT III - SSI MODELS</b>	<b>(9)</b>
Elastic continuum, Winkler's model, Multi parameter models, Hybrid models, Codal provisions, Machine foundation - Idealization of semi-infinite and finite beams - Analysis of finite plates, rectangular and circular plates - Numerical analysis of finite plates - simple solutions	
<b>UNIT IV - ELASTIC ANALYSIS OF PILE</b>	<b>(9)</b>
Elastic analysis of single pile, Theoretical solutions for settlement and load distribution, Analysis of pile group, Interaction analysis, Load distribution in groups with rigid cap.	
<b>UNIT V - SSI IN RETAINING STRUCTURES</b>	<b>(9)</b>
Curved failure surfaces, their utility and analytical / graphical predictions from Mohr - Coulomb envelope and circle of stress, Earth pressure computations by friction circle method, Earth pressure on wall with limited / restrained deformations, Earth pressure on sheet piles, braced excavations, Design of supporting system for excavations.	
<b>TOTAL (L:45) : 45 PERIODS</b>	

**REFERENCES:**

1. Chandrakant S. Desai, Musharraf Zaman. "Advanced Geotechnical Engineering - Soil-Structure Interaction using Computer and Material Models", 1st Edition, CRC Press (Taylor and Francis group), 2010.
2. Michael J Tomlinson, John C Woodward. "Pile Design and Construction Practice". 6th Edition, CRC Press, 2014.
3. Edward Tsodik. "Analysis of Structures on Elastic Foundations". 1st Edition, J. Ross Publishing, Cengage learning, Delhi, 2013.

**Mapping of COs with POs / PSOs**

COs	POs						PSOs	
	1	2	3	4	5	6	1	2
1	2		2			2		2
2	2		3	2		2	2	3
3			3			2		3
4	2	2	3	2	2	3	2	3
5	3	2	3	3	2	3	3	3
<b>CO (W.A)</b>	<b>2.25</b>	<b>2</b>	<b>2.8</b>	<b>2.33</b>	<b>2</b>	<b>2.4</b>	<b>2.33</b>	<b>2.8</b>

*Dr. N. S. Arora*

22STX04 - PREFABRICATED STRUCTURES					
		<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>PRE REQUISITE : NIL</b>					
<b>Course Objectives</b>			<b>Course Outcomes</b>		
<b>1.0</b>	To study the principles designing prefabricated structures	<b>1.1</b>	The students will be able to apply the basic principles to compare monolithic construction and prefabrication		
<b>2.0</b>	To impart Knowledge on pre fabricated elements and the technologies used in fabrication and erection	<b>2.1</b>	The students will be able to classify the types of prefabricated elements.		
<b>3.0</b>	To study the behavior and design principles of elements	<b>3.1</b>	The students will be able to design for stripping forces during manufacture		
<b>4.0</b>	To understand the concept of Eccentricity and stability	<b>4.1</b>	The students will be able to determine the forces in shear walls		
<b>5.0</b>	To give an exposure on of prefabricated components in industrial buildings	<b>5.1</b>	The students will be able to identify the different roof trusses used in industrial buildings		
<b>UNIT I - DESIGN PRINCIPLES</b>					<b>(9)</b>
General Civil Engineering requirements, specific requirements for planning and layout of prefabrication plant. Modular co-ordination, standardization, Disuniting of Prefabricates, production, transportation, erection - elimination of erection stresses, stages of loading and code provisions, safety factors.					
<b>UNIT II - PREFABRICATED ELEMENTS</b>					<b>(9)</b>
Roof and floor panels, ribbed floor panels - wall panels - footings - Joints for different structural Connections - Effective sealing of joints for water proofing - Provisions for non - structural fastenings - Expansion joints in pre-cast construction.					
<b>UNIT III - FLOORS, STAIRS AND ROOFS</b>					<b>(9)</b>
Types of floor slabs, analysis and design example of cored and panel types and two-way systems, Design analysis for product manufacture, handling and erection, staircase slab, types of roof slabs and insulation requirements, behaviour and reinforcement requirements, Deflection control for short term and long term loads.					
<b>UNIT IV - WALLS</b>					<b>(9)</b>
Types of wall panels, Blocks and large panels, Curtain, Partition and load bearing walls, load transfer from floor to wall panels, vertical loads, Eccentricity and stability of wall panels, Design Curves, types of wall joints, their behaviour and design, Leak prevention, joint sealants, sandwich wall panels, Lateral load resistance, Location and types of shear walls, approximate design of shear walls.					
<b>UNIT V - INDUSTRIAL BUILDINGS AND SHELL ROOFS</b>					<b>(9)</b>
Components of single-storey industrial sheds with crane gantry systems, R.C. Roof Trusses, Roof Panels, corbels and columns, wind bracing. Cylindrical, Folded plate and paraboloid shells, Erection and jointing of components in industrial buildings - Application of prestressed concrete in prefabrication- Pre Engineered Buildings Vs Conventional Steel Buildings - Advantages					
<b>TOTAL (L:45) : 45 PERIODS</b>					



**REFERENCES:**

1. Laszlo Makk, "Prefabricated Concrete for Industrial and Public Structures", Akademiai Kiado, Budapest, 2007.
2. Hubert Bachmann and Alfred Steinle, "Precast Concrete Structures", 2012.
3. Koncz.T, "Manual of Precast Concrete Construction", Vol.I II and III & IV Bauverlag, GMBH, 1971.
4. "Structural Design Manual, Precast Concrete Connection Details", Society for the Studies in the use of Precast Concrete, Netherland Betor Verlag, 2009.

Mapping of COs with POs / PSOs								
COs	POs						PSOs	
	1	2	3	4	5	6	1	2
1			2	2		3	3	2
2	1					2	2	2
3	2		2	2	3	2	3	
4	3	2	2	3	3	2	2	2
5	1		2	2				2
<b>CO (W.A)</b>	<b>1.75</b>	<b>2</b>	<b>2</b>	<b>2.25</b>	<b>3</b>	<b>2.25</b>	<b>2.5</b>	<b>2</b>

*Dr. H. Bachmann*

22STX06 - DESIGN OF PLATES AND SHELLS					
		<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>PRE REQUISITE : NIL</b>					
<b>Course Objectives</b>			<b>Course Outcomes</b>		
<b>1.0</b>	To understand the behaviour and analysis of plate and shell structures	<b>1.1</b>	The students will be able to explain the concepts of plate structures		
<b>2.0</b>	To analyse the behaviour of plate as per codal recommendations	<b>2.1</b>	The students will be able to analyze plate structures various structural loadings		
<b>3.0</b>	To impart knowledge about the behavior of shell structures	<b>3.1</b>	The students will be able to identify the characteristics and structural behaviour of shells		
<b>4.0</b>	To analyse the behaviour of shells using standard theories	<b>4.1</b>	The students will be able to apply the knowledge of bending theory in shell structures		
<b>5.0</b>	To understand the design concepts of plates and shell structures	<b>5.1</b>	The students will be able to design the various plates and shell structures		
<b>UNIT I - INTRODUCTION TO PLATE STRUCTURES</b>					<b>(9)</b>
Thin and thick plates - Structural action of plates - Assumptions involved in plate theories - Differential equation for cylindrical bending of plates - Cylindrical bending of uniformly loaded rectangular plates with simply supported and built-in edges - Small deflection theory of laterally loaded rectangular plates - Kirchoffs boundary conditions Corner effects					
<b>UNIT II - ANALYSIS OF PLATE STRUCTURES</b>					<b>(9)</b>
Simply supported rectangular plates under Sinu-soidal load - Navier solution - Levys method - Symmetrical bending of laterally loaded circular plates - Circular plates with simply supported and built-in edges - Bending of annular plates.					
<b>UNIT III - INTRODUCTION TO SHELL STRUCTURES</b>					<b>(9)</b>
Classification of shells - Membrane action - Stressed shell element and stress resultants - Load transfer mechanism - Characteristics of shell surfaces -Structural behaviour of shells - Membrane theory of cylindrical shells					
<b>UNIT IV - ANALYSIS OF SHELL STRUCTURES</b>					<b>(9)</b>
Bending theory of circular cylindrical shells - Comparison of various bending theories - Introduction to other types of shells					
<b>UNIT V- DESIGN OF PLATES AND SHELL STRUCTURES</b>					<b>(9)</b>
Necessary design inputs - Detailed design - Prismatic folded plates - Circular cylindrical barrel shell roofs - Spherical dome - Conical dome - HYPAR shell - Helicoids					
<b>TOTAL (L:45) : 45 PERIODS</b>					

**REFERENCES:**

1. G.S.Ramaswamy, "Design & Construction of Concrete Shell Roofs", 1st Edition, CBS publishers & distributors Pvt. Ltd, New Delhi, 2005.
2. Timoshenko and Krieger, Theory of Plates and Shells, McGraw Hill Inc, 2nd Edition, New Delhi, 2017
3. Varghese. P.C., Design of Reinforced Concrete Shells and Folded Plates, PHI Learning Pvt.Ltd., 2010

**Mapping of COs with POs / PSOs**

COs	POs						PSOs	
	1	2	3	4	5	6	1	2
1						2		2
2	2			3	2	3	2	3
3			2			2	2	
4	2		2		2	3		3
5	2			2	3	2	2	3
<b>CO (W.A)</b>	<b>2</b>		<b>2</b>	<b>2.5</b>	<b>2.33</b>	<b>2.4</b>	<b>2</b>	<b>2.75</b>



22STX09 - MAINTENANCE AND REHABILITATION OF STRUCTURES					
		<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>PRE REQUISITE : NIL</b>					
Course Objectives			Course Outcomes		
<b>1.0</b>	To emphasize the importance of maintenance and inspection of structures	<b>1.1</b>	The students will be able to explain the importance of maintenance assessment and repair strategies		
<b>2.0</b>	To get the knowledge on strength and durability of concrete with effects due to environment, chemicals, fire and earthquakes.	<b>2.1</b>	The students will be able to identify the effects due to climate and temperature		
<b>3.0</b>	To gain knowledge about the materials for repair.	<b>3.1</b>	The students will be able to realize the basic concepts, materials and techniques available for repair works.		
<b>4.0</b>	To impart fundamental knowledge on various repairing strategies	<b>4.1</b>	The students will be able to explain the techniques for repair and protection methods		
<b>5.0</b>	To impart a broad knowledge in the area of repair and rehabilitation of structures	<b>5.1</b>	The students will be able to identify the suitable methods for the repair, retrofitting and demolition of structures		

<b>UNIT I - MAINTENANCE AND REPAIR STRATEGIES</b>	<b>(9)</b>
Maintenance, Repair and Rehabilitation, retrofit and strengthening, need for rehabilitation of structures - Service life behaviour - importance of Maintenance, causes and effects of deterioration. Non-destructive Testing Techniques	
<b>UNIT II - STRENGTH AND DURABILITY OF CONCRETE</b>	<b>(9)</b>
Quality assurance for concrete based on Strength, Durability and Microstructure of concrete - NDT techniques- Cracks- different types, causes - Effects due to Environment, Fire, Earthquake, Corrosion of steel in concrete, Mechanism, quantification of corrosion damage	
<b>UNIT III - REPAIR MATERIALS AND SPECIAL CONCRETES</b>	<b>(9)</b>
Repair materials - Various repair materials, Criteria for material selection, Methodology of selection, Special mortars and concretes - Polymer Concrete and Grouting materials - Bonding agents - Latex emulsions, Epoxy bonding agents, Protective coatings - Protective coatings for Concrete and Steel, FRP sheets.	
<b>UNIT IV - PROTECTION METHODS AND STRUCTURAL HEALTH MONITORING</b>	<b>(9)</b>
Concrete protection methods - reinforcement protection methods - cathodic protection - Sacrificial anode - Corrosion protection techniques - Corrosion inhibitors, concrete coatings - Corrosion resistant steels, Coatings to reinforcement, Structural health monitoring	
<b>UNIT V - REPAIR, RETROFITTING AND DEMOLITION OF STRUCTURES</b>	<b>(9)</b>

Various methods of crack repair, Grouting, Routing and sealing, Stitching, Dry packing, Autogenous healing, Repair to active cracks, Repair to dormant cracks - Repair of various corrosion damaged of structural elements (slab, beam and columns) Jacketing Techniques, Strengthening Methods for Structural Elements. Engineered Demolition - Case studies

**TOTAL (L:45) : 45 PERIODS**

**REFERENCES:**

1. Ravishankar.K., Krishnamoorthy. T.S, “Structural Health Monitoring, Repair and Rehabilitation of Concrete Structures”, Allied Publishers, 2004
2. Denison Campbell, Allen and Harold Roper, “Concrete Structures, Materials, Maintenance and Repair”, Longman Scientific and Technical, UK, 1991.
3. Dayaratnam P. and Rao R., “Maintenance and Durability of Concrete Structures”, 1st Edition, University Press, India, 1997
4. Santhakumar. A.R., “Training Course Notes on Damage Assessment and Repair in Low Cost Housing”, “RHDC- NBO”, Anna University, July, 1992.
5. Dodge Woodson, “Concrete Structures, Protection, Repair and Rehabilitation”, Butterworth - Heinemann, Elsevier, New Delhi 2012

**Mapping of COs with POs / PSOs**

COs	POs						PSOs	
	1	2	3	4	5	6	1	2
1	2		3	3		2	2	
2				2		3		3
3			2	3	2	3	3	3
4	2		2			2	3	2
5	3		3	2		3	3	3
<b>CO (W.A)</b>	<b>2.5</b>		<b>2.5</b>	<b>2.5</b>	<b>2</b>	<b>2.6</b>	<b>2.75</b>	<b>2.75</b>



**22STX17 - STRUCTURAL HEALTH MONITORING**

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

**PRE REQUISITE : NIL**

<b>Course Objectives</b>		<b>Course Outcomes</b>	
<b>1.0</b>	To learn concepts involved SHM advantages and challenges	<b>1.1</b>	The students will be able to adopt a proper health monitoring technique
<b>2.0</b>	To develop knowledge on sensor technique	<b>2.1</b>	The students will be able to suggest the materials and techniques used for repair of structures.
<b>3.0</b>	To learn different static and dynamic measurement techniques	<b>3.1</b>	The students will be able to identify the suitable static and dynamic measurement technique
<b>4.0</b>	To Gain Knowledge about Damage Detection techniques	<b>4.1</b>	The students will be able to compare the various damage detection techniques
<b>5.0</b>	To impart knowledge on both elementary and advanced applications of SHM with case studies	<b>5.1</b>	The students will be able to apply the various data processing methods through case studies

**UNIT I - INTRODUCTION TO STRUCTURAL HEALTH MONITORING**

**(9)**

Need for SHM, Structural Health Monitoring versus Non-Destructive Evaluation, Methods of SHM Local & Global Techniques for SHM, Short & Long -Term Monitoring, Active & Passive Monitoring, Remote Structural Health Monitoring- Advantages of SHM - Challenges in SHM

**UNIT II - SENSORS AND INSTRUMENTATION FOR SHM**

**(9)**

Sensors for measurements: Electrical Resistance Strain Gages, Vibrating Wire Strain Gauges, Fiber Optic Sensors, Temperature Sensors, Accelerometers, Displacement Transducers, Load Cells, Humidity Sensors, Crack Propagation Measuring Sensors, Corrosion Monitoring Sensors, Pressure Sensors, Data Acquisition - Data Transmission - Data Processing - Storage of processed data - Knowledgeable information processing

**UNIT III - STATIC AND DYNAMIC MEASUREMENT TECHNIQUES FOR SHM**

**(9)**

Static measurement - Load test, Concrete core trepanning, Flat jack techniques, Static response measurement, Dynamic measurement - Vibration based testing - Ambient Excitation methods, Measured forced Vibration-Impact excitation, step relaxation test, shaker excitation method.

**UNIT IV - DAMAGE DETECTION**

**(9)**

Damage Diagnostic methods based on vibration response - Method based on modal frequency/shape/damping, Curvature and flexibility method, Modal strain energy method, Sensitivity method, Baseline-free method, Cross-correlation method, Damage Diagnostic methods based on wave propagation Methods-Bulk waves/Lamb waves, Reflection and transmission, Wave tuning/mode selectivity, Migration imaging, Phased array imaging, Focusing

array/SAFT imaging

**UNIT V - DATA PROCESSING AND CASE STUDIES**

**(9)**

Advanced signal processing methods -Wavelet, Hilbert-Huang transform, Neural networks, Support Vector Machine Principal component analysis, Outlier analysis. Applications of SHM on bridges and buildings, case studies of SHM in Civil / Structural engineering.

**TOTAL (L:45) : 45 PERIODS**

**REFERENCES:**

1. Daniel Balageas, Peter Fritzen, Alfredo Guemes, "Structural Health Monitoring", John Wiley & Sons, 2006.
2. Douglas E Adams, "Health Monitoring of Structural Materials and Components Methods with Applications", Wiley Publishers, 2007
3. Hua-Peng Chen, "Structural Health Monitoring of Large Civil Engineering Structures", Wiley Publishers, 2018
4. Ansari, F Karbhari, "Structural health monitoring of Civil Infrastructure Systems", V.M, Woodhead Publishing, 2009

**Mapping of COs with POs / PSOs**

COs	POs						PSOs	
	1	2	3	4	5	6	1	2
1			2	2		2		2
2			3	3	3	3	3	3
3			2		2		2	2
4	2			2			3	2
5	2			2		2	2	
<b>CO (W.A)</b>	<b>2</b>		<b>2.33</b>	<b>2.25</b>	<b>2.5</b>	<b>2.33</b>	<b>2.5</b>	<b>2.25</b>

*Dr. N. S. Narayana*

**22STX19 - DESIGN OF FORM WORK**  
(IS 14687 code is to be permitted)

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

**PRE REQUISITE : NIL**

<b>Course Objectives</b>		<b>Course Outcomes</b>	
<b>1.0</b>	To study and understand the detailed planning of formwork	<b>1.1</b>	The students will be able to select proper formwork
<b>2.0</b>	To know the formwork materials and types	<b>2.1</b>	The students will be able to select accessories and material for form work
<b>3.0</b>	To Design formwork for various elements such as foundation, slabs, beams, columns and walls.	<b>3.1</b>	The students will be able to design the form work for Beams, Slabs, columns, Walls and Foundations
<b>4.0</b>	To Design forms for various special structures like domes, towers, bridges	<b>4.1</b>	The students will be able to design the form work for Special Structures
<b>5.0</b>	To identify the causes and failures of form work	<b>5.1</b>	The students will be able to judge the formwork failures through case studies

**UNIT I - INTRODUCTION**

**(9)**

General objectives of formwork building - Development of a Basic System - Key Areas of cost reduction - Requirements and Selection of Formwork

**UNIT II - FORMWORK MATERIALS AND TYPES**

**(9)**

Timber, Plywood, Steel, Aluminium, Plastic, and Accessories. Horizontal and Vertical Formwork Supports. Flying Formwork, Table Form, Tunnel Form, Slip Form, Formwork for Precast Concrete

**UNIT III - FORMWORK DESIGN**

**(9)**

Concepts, Formwork Systems and Design for Foundations, Walls, Columns, Slab and Beams

**UNIT IV - FORMWORK DESIGN FOR SPECIAL STRUCTURES**

**(9)**

Shells, Domes, Folded Plates, Overhead Water Tanks, Natural Draft Cooling Tower, Bridges.

**UNIT V - FORMWORK FAILURES**

**(9)**

Formwork Management Issues - Pre- and Post - Award. Formwork Failures: Causes and Case studies in Formwork Failure, Formwork Issues in Multi story Building Construction

**TOTAL (L:45) : 45 PERIODS**



**REFERENCES:**

1. R.L.Peurifoy, "Formwork for Concrete Structures", McGraw Hill India, 2010.
2. Kumar Neeraj Jha, "Formwork for Concrete Structures", Tata McGraw Hill Education, 2012.
3. Hurd M.K., "Formwork for Concrete", Special Publication No.4, American Concrete Institute, Detroit, 1996
4. Michael P. Hurst, Construction Press, London and New York, 2003.
5. IS 14687: 1999, "False work for Concrete Structures - Guidelines", BIS

Mapping of COs with POs / PSOs								
COs	POs						PSOs	
	1	2	3	4	5	6	1	2
1			2		2	2		2
2				2	2			
3			2	3	2		2	2
4				2	2		2	
5	2		2	2			2	
<b>CO (W.A)</b>	<b>2</b>		<b>2</b>	<b>2.25</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>2</b>



**22STX20 - GREEN BUILDING MANAGEMENT**

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

**PRE REQUISITE : NIL**

<b>Course Objectives</b>		<b>Course Outcomes</b>	
<b>1.0</b>	To understand the concept of green building concept	<b>1.1</b>	The students will be able to understand the concepts of green building
<b>2.0</b>	To Understand the green rating system	<b>2.1</b>	The students will be able to summarize the existing green building rating systems
<b>3.0</b>	To design the alternate material	<b>3.1</b>	The students will be able to apply alternate construction materials and methods
<b>4.0</b>	To Highlight strategies to integrate energy efficient buildings	<b>4.1</b>	The students will be able to rate the green buildings
<b>5.0</b>	To analyses the green building rating system	<b>5.1</b>	The students will be able to survey the codes for certification of green construction.

**UNIT I - INTRODUCTION TO IGBC AND GREEN BUILDING CONCEPT****(9)**

Green Building Concept - Introduction to IGBC- Green Building Rating Tools - Green Project Management and Certification - Documentation and Certification

**UNIT II - INTRODUCTION TO GREEN RATING SYSTEMS****(9)**

History of green Rating systems - LEED, GRIHA, BREEAM, IGBC - Need and use of green rating systems - Structure of the rating systems - Market response to various rating systems - Selection of the appropriate rating system. ZEB - NZEB -ZCB ratings

**UNIT III - ALTERNATIVE CONSTRUCTION MATERIALS AND METHODS****(9)**

Building and Material Reuse - Salvaged Materials - Material Content - Manufactured Materials - Recycled Content - Eco Block - Volatile Organic Compounds (VOC's) Natural Non-Petroleum Based Materials - Alternative Construction Methods - Waste Management and Recycling - Design For Deconstruction

**UNIT IV - PERFORMANCE TESTING****(9)**

Cost and Performance Comparisons and Benchmarking - Building Modeling & Energy Analysis - Cost Benefit Analysis - Energy, Shell and Systems Installation Testing - Blower Door - Duct Tightness - Thermal Imagery - Air Quality - Moisture Testing - Commissioning, Metering, Monitoring -Weatherization - Air Sealing – HVAC - Moisture Control - Energy Retrofits and Green Remodels

**UNIT V - FUTURE OF BUILDING RATING SYSTEMS****(9)**

Role of Green building consultant - Determining the various green points - Green Accreditation examinations - Energy modeling and energy auditing in green building ratings - Consultancy scope and services for green rating systems - Codes and Certification Programs - Green Rating Registration - Green Remodel Ratings - International Green Construction Codes and ratings - Service life span - Case Study

**TOTAL (L:45) : 45 PERIODS**

**REFERENCES:**

1. Linda Reeder, "Guide to green building rating systems ", 3rd Edition, John Wiley & Sons, 2010.
2. Dru Meadows," Preparing a Building Service Life Plan for Green Buildings", McGraw-Hill Publications, 1st Edition, 2014.
3. Abe Kruger," Green Building: Principles and Practices in Residential Construction", 1st Edition, Cengage learning India Pvt Ltd, 2012.

**Mapping of COs with POs / PSOs**

COs	POs						PSOs	
	1	2	3	4	5	6	1	2
1	2		2	2	3		2	3
2			2			2		3
3		2	2	3		2	3	3
4				2		2		2
5			2		3	2	3	3
<b>CO (W.A)</b>	<b>2</b>	<b>2</b>	<b>2</b>	<b>2.33</b>	<b>3</b>	<b>2</b>	<b>2.67</b>	<b>2.8</b>

*Dr. Neelam Bhat*

**22STX21 - RISK AND RELIABILITY OF STRUCTURES**

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

**PRE REQUISITE : NIL**

<b>Course Objectives</b>		<b>Course Outcomes</b>	
<b>1.0</b>	To understand the concepts in probability and plausibility.	<b>1.1</b>	The students will be able to relate the different approaches to quantify uncertainties and plausible reasoning
<b>2.0</b>	To learn about modelling random variables and sampling estimates	<b>2.1</b>	The students will be able to analyse the structural reliability on structure
<b>3.0</b>	To introduce the basics of structural reliability and analysis procedures	<b>3.1</b>	The students will be able to analyse the reliability by error estimation and examine the failure patterns
<b>4.0</b>	To impart knowledge on reliability based design and principles underlying code calibration	<b>4.1</b>	The students will be able to propose a mechanical model for reliability analysis and studies on behaviour of tubular joints
<b>5.0</b>	To understand the importance of safety and reliability issues of offshore facilities during analysis, design, inspection and planning	<b>5.1</b>	The students will be able to analyse and manage risk by Fault Tree Analysis, Event Tree Analysis

**UNIT I - PROBABILITY AND PLAUSIBILITY****(9)**

Introduction - Types of uncertainties- Probability - Probabilistic and non-probabilistic methods - Modular Bayesian Approach - Frequentist Approach - Rules of probability - Plausible reasoning - Quantitative rules

**UNIT II - MODELLING RANDOM VARIABLES AND SAMPLING ESTIMATES****(9)**

Probability distribution - Random variables - Sampling estimates - Modelling of environmental loads structural reliability - variables in reliability analysis

**UNIT III - RELIABILITY ANALYSIS****(9)**

Components of reliability analysis - Levels of Reliability-Error estimation - Reliability methods-System Reliability -Failure domains - Application problems

**UNIT IV - MECHANICAL MODELS AND FATIGUE RELIABILITY****(9)**

Codes on structural reliability - Mechanical models in Reliability analysis-Stochastic process - Fatigue reliability - Design SN curve - Simplified Fatigue Assessment - Short term fatigue damage - Behaviour of tubular joints - Experimental studies on Tubular joints

**UNIT V - RISK AND RELIABILITY****(9)**

Risk Assessment-Logical Risk Analysis - Risk Analysis of Mechanical Systems-FMEA - Fault Tree Analysis - Event Tree Analysis - Consequence Analysis - Risk Acceptability-Risk and Hazard Assessment - Risk Management

**TOTAL (L:45) : 45 PERIODS**

**REFERENCES:**

1. Chakrabarti, S.K. "Non-linear Method in Offshore Engineering", Elsevier Science Publisher, The Netherlands, 1990
2. Chandrasekaran, S. and Bhattacharyya, S.K. "Analysis and Design of Offshore Structures", HRD Center for offshore and Plant Engineering (HOPE), Changwon National University, Republic of Korea, pp. 285. 2011
3. Cowell RG, Dawid AP, Lauritzen SL, Spiegelhalter DJ. "Probabilistic networks and expert systems", New York: Springer; 1999.
4. Halder, A. and Mahaderan, S., "First order and Second order Reliability Method Probabilistic Structural Mechanics Hand Book, Edited by C. (Raj) Sundararajan, Chapman and Hall, PP. 27-52, 1995.
5. Srinivasan Chandrasekaran. "Offshore structural engineering: Reliability and Risk Assessment", CRC Press, Florida, ISBN:978-14-987-6519-0, 2016

Mapping of COs with POs / PSOs								
COs	POs						PSOs	
	1	2	3	4	5	6	1	2
1	2			2		2		2
2			1	3		1	2	2
3			2	2	3	2	3	2
4			2	2		1		2
5			2	2			2	
<b>CO (W.A)</b>	<b>2</b>		<b>2.33</b>	<b>2.2</b>	<b>3</b>	<b>1.5</b>	<b>2.33</b>	<b>2</b>

*Srinivasan Chandrasekaran*

**22STX22 - DESIGN OF STEEL CONCRETE COMPOSITE STRUCTURES**  
(IS: 800-2007, IS 11384-1985 & EURO code-4 are to be permitted)

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

**PRE REQUISITE : NIL**

Course Objectives		Course Outcomes	
1.0	To develop an understanding of the behaviour and design procedure of steel - concrete composite elements and structures.	1.1	The students will be able to identify the different types of steel-concrete composite structures
2.0	To study the design of composite beams and columns	2.1	The students will be able to design the composite beam and column.
3.0	To acquire knowledge about the composite trusses	3.1	The students will be able to apply the studs in roofs and slabs and predict the cracking pattern.
4.0	To gain knowledge about composite box girder bridges, vibration of composite section and cyclic behavior of composite sections	4.1	The students will be able to analyze the various bridges and design the economical one
5.0	To give an exposure on case studies related to steel-concrete composite construction.	5.1	The students will be able to study and evaluate case studies

<b>UNIT I - INTRODUCTION</b>	<b>(9)</b>
Introduction to steel - concrete composite construction - Advantages - Theory of composite structures - Introduction to steel - Concrete - Steel sandwich construction	
<b>UNIT II - DESIGN OF COMPOSITE BEAMS AND SLABS</b>	<b>(9)</b>
Behaviour of composite beams - Design of composite beams including shear connector - Behaviour and design of composite columns and composite slab	
<b>UNIT III - COMPOSITE TRUSSES</b>	<b>(9)</b>
Introduction - Stud shear connectors - Effective Concrete Slab - Design consideration: Preliminary design, detailed analysis and design - Design of studs - Partial shear - Concrete cracking - Practical considerations - Cost implications - Design problems	
<b>UNIT IV - COMPOSITE BRIDGES</b>	<b>(9)</b>
Introduction - design of composite bridge deck - Composite box girder bridges - Behaviour of composite box girder bridges - Design concepts	
<b>UNIT V - GENERAL</b>	<b>(9)</b>
Case studies on steel - Concrete composite construction - Seismic behavior of composite structures	
<b>TOTAL (L:45) : 45 PERIODS</b>	

**REFERENCES:**

1. Johnson R.P., "Composite Structures of Steel and Concrete Beams, Slabs, Columns and Frames for Buildings", Vol. I, 4th Edition, Blackwell Scientific Publications, 2018
2. Oehlers D.J. and Bradford M.A., "Composite Steel and Concrete Structural Members, Fundamental behaviour", Revised Edition, Pergamon press, Oxford, 2013.
3. Owens. G.W and Knowles. P,"Steel Designers Manual", 7th Edition, Steel Concrete Institute(UK), Oxford Blackwell Scientific Publications, 2011.
4. Narayanan R, "Composite steel structures - Advances, design and construction", Elsevier, Applied science, UK, 1987

Mapping of COs with POs / PSOs								
COs	POs						PSOs	
	1	2	3	4	5	6	1	2
1	2		2	3		2	2	3
2			3	2	3	2	3	3
3		2	2	2			2	2
4	2		3	2	3	3	3	3
5	2			2			2	
<b>CO (W.A)</b>	<b>2</b>	<b>2</b>	<b>2.5</b>	<b>2.2</b>	<b>3</b>	<b>2.33</b>	<b>2.4</b>	<b>2.75</b>

*Dr. M. S. Srinivasan*