# PANIMALAR ENGINEERING COLLEGE

*Approved by AICTE, New Delhi | Affiliated to Anna University, Chennai*

## B.E - CIVIL ENGINEERING

## REGULATION 2021

## CURRICULUM & SYLLABUS

# PANIMALAR ENGINEERING COLLEGE

*(An Autonomous Institution, Affiliated to Anna University, Chennai)*
*Bangalore Trunk Road, Varadharajapuram,*
**Poonamallee, Chennai – 600 123.**

# Department of Civil Engineering
# B.E- Civil Engineering

## CURRICULUM AND SYLLABUS

## REGULATION-2021

# DEPARTMENT OF CIVIL ENGINEERING

## VISION

To build young Technocrats by imparting their technical knowledge in the field of civil engineering, by laying the foundation for future engineers, who can meet the demands of industry and community effectively in all part of civil works and to make significant contribution in the economic development of the state, region and nation.

## MISSION

**M1:** To adopt valuable teaching methods and implement high quality education to maximize Engineering knowledge for students.

**M2:** To promote innovative and original thoughts in the minds of civil engineers.

**M3:** To provide facilities to the students and faculty members to enhance the understanding and implementation of recent trends in the Civil Engineering field.

**M4:** To produce Civil Engineering graduates with good ethical skills and managerial skills to become as successful professionals and entrepreneurs.

**M5:** To promote advanced technology, Industry Institute interaction, research and consultancy in Civil Engineering department with global linkages.

## PROGRAMME EDUCATIONAL OBJECTIVES (PEO)

PEO 1

To educate the graduates with the basic and advanced knowledge in civil engineering and to apply the fundamentals of mathematics, science, management and computing in Engineering principles.

**Learning and Incubation PEO 2**

To motivate themselves in getting engineering position and practice with structural design, construction industries in private and government sectors at the national and international levels.

**Mastery and Career Contribution PEO 3**

To succeed and prepare the civil engineering graduates in lifelong independent learning and work effectively on team based projects to become good entrepreneurs and conduct themselves ethically, socially in their professional environment.

**Sustained Learning PEO 4**

Graduates will be made aware of causes of impacts due to the development and also to identify remedial measures if necessary.

**Awareness of Social impact PEO 5**

To prepare students to become successful design engineers, R&D scientists. Civil Engineering Graduates will exhibit interest in leading to professional licensure or higher studies in engineering that provides for continued development of their technical ability and management skills.

# PROGRAM OUTCOMES (PO)

1. **Engineering knowledge:**

Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem Analysis:**

Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions:**

Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems:**

Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information

5. **Modern tool usage:**

Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

6. **The engineer and society**

Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and Sustainability**

Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of need for sustainable development.

8. **Ethics**

Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and Team Work**

Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication**

Communicate effectively on complex engineering activities with the engineering community and with society at large. Some of them are, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project Management and Finance**

Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Lifelong learning**

Recognise the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change**.**

# PROGRAMME SPECIFIC OUTCOMES (PSO)

**PSO 1**

Draft specification: Select material, prepare estimates/costing, schedule work plans.

**PSO 2**

Experimentation: Apply knowledge of different fields of Civil Engineering, conduct experiments, analyze, interpret data, and design the system components.

**PSO 3**

Project inception and design: Conceptualize projects related to different fields of Civil Engineering, collect relevant data by direct and indirect methods, analyze the project requirement and design the project.

**PEOs & POs**

The B.E. Civil Engineering Program outcomes leading to the achievement of the objectives are summarized in the following Table.

# PANIMALAR ENGINEERING COLLEGE

(An Autonomous Institution, Affiliated to Anna University, Chennai)

**B.E- CIVIL ENGINEERING**

**CHOICE BASED CREDIT SYSTEM**

**CURRICULA AND SYLLABI- R 2021**

**SEMESTER – I**

| Sl. No | COURSE CODE | COURSE TITLE | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| **THEORY** | | | | | | | | |
| 1. | 21HS1101 | Communicative English & Language SkillsLab I Integrated | HS | 5 | 3 | 0 | 2 | 4 |
| 2. | 21MA1101 | Engineering Mathematics – I | BS | 4 | 3 | 1 | 0 | 4 |
| 3. | 21PH 1101 | Engineering Physics | BS | 3 | 3 | 0 | 0 | 3 |
| 4. | 21CY1101 | Engineering Chemistry | BS | 3 | 3 | 0 | 0 | 3 |
| 5. | 21ES1101 | Problem Solving and Python programming | ES | 3 | 3 | 0 | 0 | 3 |
| 6. | 21ES1102 | Engineering Graphics | ES | 5 | 3 | 0 | 2 | 4 |
| **PRACTICALS** | | | | | | | | |
| **7.** | 21ES1111 | Problem Solving and Python programming Laboratory | ES | 4 | 0 | 0 | 4 | 2 |
| 8. | 21BS1111 | Physics and Chemistry Laboratory | BS | 4 | 0 | 0 | 4 | 2 |
| | | | **TOTAL** | **31** | **18** | **1** | **12** | **25** |

**SEMESTER – II**

| Sl. No | COURSE CODE | COURSE TITLE | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|---|
| **THEORY** | | | | | | | | |
| 1. | 21HS1201 | Communicative English & Language skills Lab II Integrated | HS | 5 | 3 | 0 | 2 | 4 |
| 2. | 21MA1201 | Engineering Mathematics - II | BS | 4 | 3 | 1 | 0 | 4 |
| 3. | 21PH1202 | Physics for Civil Engineering | BS | 3 | 3 | 0 | 0 | 3 |
| 4. | 21ES1203 | Basic Electrical and Electronics Engineering | ES | 3 | 3 | 0 | 0 | 3 |
| 5. | | Mandatory Course -I | MC | 2 | 2 | 0 | 0 | 0 |
| 6. | 21ME1201 | Engineering Mechanics | ES | 4 | 3 | 1 | 0 | 4 |
| **PRACTICALS** | | | | | | | | |
| 7. | 21ES1211 | Engineering Practices Laboratory | ES | 4 | 0 | 0 | 4 | 2 |
| 8. | 21CE1211 | Computer Aided Building Drawing | PC | 4 | 0 | 0 | 4 | 2 |
| | | | **TOTAL** | **29** | **17** | **2** | **10** | **22** |

## SEMESTER – III

| S. No | Subject code | Regulation 2021 | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Name of the Subject | CATEGORY | CONTACT PERIODS | L | T | P | Credits |
| **Theory Courses** | | | | | | | | |
| 1 | 21MA1303 | Transforms and Partial Differential Equations | BS | 4 | 3 | 1 | 0 | 4 |
| 2 | 21CE1301 | Engineering Geology | ES | 3 | 3 | 0 | 0 | 3 |
| 3 | 21CE1302 | Strength of Materials | PC | 3 | 3 | 0 | 0 | 3 |
| 4 | 21CE1303 | Construction Materials, Techniques and Practices | PC | 3 | 3 | 0 | 0 | 3 |
| 5 | 21CE1304 | Fluid Mechanics | PC | 3 | 3 | 0 | 0 | 3 |
| 6 | | Mandatory Course II | MC | 3 | 3 | 0 | 0 | 0 |
| Laboratory Courses | | | | | | | | |
| 7 | 21CE1311 | Strength of Materials Laboratory | PC | 4 | 0 | 0 | 4 | 2 |
| 8 | 21CE1312 | Construction Materials Laboratory | PC | 4 | 0 | 0 | 4 | 2 |
| Total | | | | 27 | 18 | 1 | 8 | 20 |

## SEMESTER – IV

| S. No | Subject code | Regulation 2021 | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Name of the Subject | CATEGORY | CONTACT PERIODS | L | T | P | Credits |
| **Theory Courses** | | | | | | | | |
| 1 | 21MA1404 | Numerical Methods | BS | 4 | 3 | 1 | 0 | 4 |
| 2 | 21CE1401 | Environmental Engineering - I | PC | 3 | 3 | 0 | 0 | 3 |
| 3 | 21CE1402 | Applied Hydraulic Engineering | PC | 3 | 3 | 0 | 0 | 3 |
| 4 | 21CE1403 | Structural Analysis - I | PC | 3 | 3 | 0 | 0 | 3 |
| 5 | 21CE1404 | Soil Mechanics | PC | 3 | 3 | 0 | 0 | 3 |
| 6 | 21CE1405 | Surveying | PC | 3 | 3 | 0 | 0 | 3 |
| Laboratory Courses | | | | | | | | |
| 7 | 21CE1411 | Survey Practical Laboratory | PC | 4 | 0 | 0 | 4 | 2 |
| 8 | 21CE1412 | Hydraulic Engineering Laboratory | PC | 4 | 0 | 0 | 4 | 2 |
| 9 | 21CE1413 | Mini Project | PC | 2 | 0 | 0 | 2 | 2 |
| Total | | | | 29 | 18 | 1 | 10 | 25 |

## SEMESTER – V

| S. No | Subject code | Regulation 2021 | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Name of the Subject | CATEGORY | CONTACT PERIODS | L | T | P | Credits |
| **Theory Courses** | | | | | | | | |
| 1 | 21HS1501 | Professional Ethics | HS | 3 | 3 | 0 | 0 | 3 |
| 2 | 21CE1501 | Foundation Engineering | PC | 3 | 3 | 0 | 0 | 3 |
| 3 | 21CE1502 | Structural Analysis – II | PC | 3 | 3 | 0 | 0 | 3 |
| 4 | 21CE1503 | Environmental Engineering - II | PC | 3 | 3 | 0 | 0 | 3 |
| 5 | 21CE1504 | Design of Reinforced Cement Concrete Structures | PC | 3 | 2 | 1 | 0 | 3 |
| 6 | | **Professional Elective – I** | PE | 3 | 3 | 0 | 0 | 3 |
| Laboratory Courses | | | | | | | | |
| 7 | 21CE1511 | Environmental Engineering Laboratory | PC | 4 | 0 | 0 | 4 | 2 |
| 8 | 21CE1512 | Soil Mechanics Laboratory | PC | 4 | 0 | 0 | 4 | 2 |
| Total | | | | 26 | 17 | 1 | 8 | 22 |

## SEMESTER – VI

| S. No | Subject code | Regulation 2021 | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Name of the Subject | CATEGORY | CONTACT PERIODS | L | T | P | Credits |
| **Theory Courses** | | | | | | | | |
| 1 | 21CE1601 | Design of Steel Structural Elements | PC | 3 | 2 | 1 | 0 | 3 |
| 2 | 21CE1602 | Highway Engineering | PC | 3 | 3 | 0 | 0 | 3 |
| 3 | | **Professional Elective – II** | PE | 3 | 3 | 0 | 0 | 3 |
| 4 | | **Professional Elective – III** | PE | 3 | 3 | 0 | 0 | 3 |
| 5 | | **Open Elective – I** | OE | 3 | 3 | 0 | 0 | 3 |
| Laboratory Courses | | | | | | | | |
| 6 | 21CE1611 | Building and Structural Engineering Drawing | PC | 4 | 0 | 0 | 4 | 2 |
| 7 | 21CE1612 | Highway Engineering Laboratory | PC | 4 | 0 | 0 | 4 | 2 |
| 8 | 21CE1613 | Survey Camp | EE | 0 | 0 | 0 | 0 | 1 |
| 9 | 21CE1614 | Quantitative Aptitude and Behavioural Skills | EE | 0 | 0 | 0 | 2 | 1 |
| 10 | 21CE1615 | In-plant Training | EE | 0 | 0 | 0 | 0 | 2 |
| Total | | | | 23 | 15 | 1 | 10 | 23 |

## SEMESTER – VII

| S. No | Subject code | Regulation 2021 | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Name of the Subject | CATEGORY | CONTACT PERIODS | L | T | P | Credits |
| **Theory Courses** | | | | | | | | |
| 1 | 21HS1701 | Total Quality Management | HS | 3 | 3 | 0 | 0 | 3 |
| 2 | 21CE1701 | Estimation, Costing and Valuation Engineering | PC | 3 | 3 | 0 | 0 | 3 |
| 3 | 21CE1702 | Irrigation Engineering | PC | 3 | 3 | 0 | 0 | 3 |
| 4 | | Professional Elective – IV | PE | 3 | 3 | 0 | 0 | 3 |
| 5 | | Professional Elective – V | PE | 3 | 3 | 0 | 0 | 3 |
| 6 | | Open Elective – II | OE | 3 | 3 | 0 | 0 | 3 |
| Laboratory Courses | | | | | | | | |
| 7 | 21CE1711 | Irrigation and Environmental Engineering Drawing | PC | 4 | 0 | 0 | 4 | 2 |
| 8 | 21CE1712 | Design Project | EE | 4 | 0 | 0 | 4 | 2 |
| Total | | | | 26 | 18 | 0 | 8 | 22 |

## SEMESTER – VIII

| S. No | Subject code | Regulation 2021 | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Name of the Subject | CATEGORY | CONTACT PERIODS | L | T | P | Credits |
| **Theory Courses** | | | | | | | | |
| 1 | | Professional Elective - VI | PE | 3 | 3 | 0 | 0 | 3 |
| 2 | | Professional Elective - VII | PE | 3 | 3 | 0 | 0 | 3 |
| Laboratory Courses | | | | | | | | |
| 3 | 21CE1811 | Project Work | EEC | 16 | 0 | 0 | 16 | 8 |
| Total | | | | 22 | 6 | 0 | 16 | 14 |

## MANDATORY COURSES

| Subject Code | COURSE TITLE | CATEGORY | CONTACT PERIODS | L | T | P | C |
|---|---|---|---|---|---|---|---|
| 21MC1001 | Environmental Science | MC | 2 | 2 | 0 | 0 | 0 |
| 21MC1002 | Constitution of India | MC | 2 | 2 | 0 | 0 | 0 |
| 21MC1003 | Human Values | MC | 2 | 2 | 0 | 0 | 0 |
| 21MC1004 | Energy Studies | MC | 2 | 2 | 0 | 0 | 0 |
| 21MC1005 | Essence of Indian Traditional Knowledge | MC | 2 | 2 | 0 | 0 | 0 |
| 21MC1006 | Soft Skills and Personality Development | MC | 2 | 2 | 0 | 0 | 0 |
| 21MC1007 | Value Education, Human Rights & Legislature Procedure | MC | 2 | 2 | 0 | 0 | 0 |

# Open Elective

### Semester VI

| S. No | Course Code | Course Title | Periods per week | | | Credits |
|---|---|---|---|---|---|---|
| | | | Lecture | Tutorial | Practical | |
| 1. | 21CE1001 | Energy conservation and management | 3 | 0 | 0 | 3 |
| 2. | 21CE1002 | Environment and Agriculture | 3 | 0 | 0 | 3 |
| 3. | 21ME1916 | Nanotechnology | 3 | 0 | 0 | 3 |
| 4. | 21ME1009 | Production Technology | 3 | 0 | 0 | 3 |
| 5. | 21ME1917 | Renewable Energy resources | 3 | 0 | 0 | 3 |
| 6. | 21EC1009 | Sensors and Transducers | 3 | 0 | 0 | 3 |
| 7. | 21CS1002 | Software Engineering | 3 | 0 | 0 | 3 |
| 8. | 21ME1907 | Noise vibration and Harshness | 3 | 0 | 0 | 3 |

### Semester VII

| S. No | Course Code | Course Title | Periods Per week | | | Credits |
|---|---|---|---|---|---|---|
| | | | Lecture | Tutorial | Practical | |
| 1. | 21CE1003 | Agricultural Finance, Banking and Co-operation | 3 | 0 | 0 | 3 |
| 2. | 21CE1004 | Global Climate change | 3 | 0 | 0 | 3 |
| 3. | 21CE1005 | Fundamentals of Planetary Remote Sensing | 3 | 0 | 0 | 3 |
| 4. | 21CE1006 | Green Building Design | 3 | 0 | 0 | 3 |
| 5. | 21ME1937 | Industrial Safety | 3 | 0 | 0 | 3 |
| 6. | 21CB1001 | Introduction to C Programming | 3 | 0 | 0 | 3 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 7. | 21EC1008 | Robotics and Automation | 3 | 0 | 0 | 3 |
| 8. | 21ME1951 | Selection of Materials | 3 | 0 | 0 | 3 |
| 9. | 21ME1905 | Testing of materials | 3 | 0 | 0 | 3 |
| 10. | 21CE1007 | Textile Effluent Treatments | 3 | 0 | 0 | 3 |

## PROFESSIONAL ELECTIVE COURSES : VERTICALS

| VERTICAL I (Structures) | VERTICALII (Construction techniques and Practices) | VERTICAL III (Geo technical) | VERTICALIV Geo-Informatics) | VERTICALV (Transportation infrastructure) | VERTICALVI (Environment) | VERTICAL VII (Water Resources) | VERTICAL VIII (Ocean Engineering) | VERTICALIX (Diversified Course) |
|---|---|---|---|---|---|---|---|---|
| 21CE1901 Concrete Structures | 21CE1908 Formwork Engineering | 21CE1915 Geo-Environmental Engineering | 21CE1922 Total Station and GPS Surveying | 21CE1929 Traffic Engineering andManagement | 21CE1936 Air and Noise Pollution Control Engineering | 21CE1943 Participatory Water Resources Management | 21CE1950 Marine Geotechnical Engineering | 21CE1957 Steel Concrete Composite Structures |
| 21CE1902 Prefabricated Structures | 21CE1909 Construction Equipment and Machinery | 21CE1916 Ground Improvement Techniques | 21CE1923 Remote Sensing Concepts | 21CE1930 Urban Planning and Development | 21CE1937 Environmental Impact Assessment | 21CE1944 Groundwater Engineering | 21CE1951 Coastal Engineering | 21CE1958 Finance For Engineers |
| 21CE1903 Prestressed Concrete Structures | 21CE1912 Advanced Construction Techniques | 21CE1917 Soil Dynamics and Machine Foundations | 21CE1924 Satellite Image Processing | 21CE1931 Smart cities | 21CE1938 Industrial Wastewater Management | 21CE1945 Water Resources Systems Engineering | 21CE1952 Off shore Structures | 21CE1959 Earth and Rockfill Dams |
| 21CE1904 Rehabilitation/ Heritage Restoration | 21CE1911 Construction Management and Safety | 21CE1918 Rock Mechanics | 21CE1925 Cartography and GIS | 21CE1932 Intelligent Transport Systems | 21CE1939 Solid and Hazardous Waste Management | 21CE1946 Watershed Conservation and Management | 21CE1953 Port and Harbour Engineering | 21CE1960 Rainwater Harvesting |
| 21CE1905 Dynamics And Earthquake Resistant Structures | 21CE1910 Sustainable Construction And Lean Construction | 21CE1919 Earth and Earth Retaining Structures | 21CE1926 Photogrammetry | 21CE1933 Pavement Engineering | 21CE1940 Environmental Policy and Legislations | 21CE1947 Integrated Water Resources Management | 21CE1954 Coastal Hazards and Mitigation | 21CE1961 Transport and Environment |
| 21CE1906 Introduction to Finite Element Method | 21CE1913 Energy Efficient Buildings | 21CE1920 Pile Foundation | 21CE1927 Hydrographic Surveying | 21CE1934 Transportation Planning Process | 21CE1941 Environment, Health and Safety | 21CE1948 Water Quality and Management | 21CE1955 Coastal Zone Management and Remote Sensing | 21CE1962 Environmental quality Monitoring |
| 21CE1907 Steel Structures | 21CE1914 Digitalized Construction Lab | 21CE1921 Tunneling Engineering | 21CE1928 Airborne and Terrestrial laser mapping | 21CE1935 Airports and Harbours | 21CE1942 Climate Change Adaptation and Mitigation | 21CE1949 Urban Water Infrastructure | 21CE1956 Ocean Wave Dynamics | 21CE1963 Computational Fluid Dynamics |

## PROFESSIONAL ELECTIVE COURSES VERTICALS

### VERTICAL I: STRUCTURES

| S. NO. | COURSE CODE | COURSE TITLE | CATEGORY | PERIODS PER WEEK | | | TOTAL CONTACT PERIODS | CREDITS |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | |
| 1. | 21CE1901 | Concrete Structures | PE | 3 | 0 | 0 | 3 | 3 |
| 2. | 21CE1902 | Prefabricated Structures | PE | 3 | 0 | 0 | 3 | 3 |
| 3. | 21CE1903 | Prestressed Concrete Structures | PE | 3 | 0 | 0 | 3 | 3 |
| 4. | 21CE1904 | Rehabilitation / Heritage Restoration | PE | 3 | 0 | 0 | 3 | 3 |
| 5. | 21CE1905 | Dynamics and Earthquake Resistant Structures | PE | 3 | 0 | 0 | 3 | 3 |
| 6. | 21CE1906 | Introduction to Finite Element Method | PE | 3 | 0 | 0 | 3 | 3 |
| 7. | 21CE1907 | Steel Structures | PE | 3 | 0 | 0 | 3 | 3 |

### VERTICAL II: CONSTRUCTION TECHNIQUES AND PRACTICES

| S. NO. | COURSE CODE | COURSE TITLE | CATEGORY | PERIODS PERWEEK | | | TOTAL CONTACT PERIODS | CREDITS |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | |
| 1. | 21CE1908 | Formwork Engineering | PE | 3 | 0 | 0 | 3 | 3 |
| 2. | 21CE1909 | Construction Equipment and Machinery | PE | 3 | 0 | 0 | 3 | 3 |
| 3. | 21CE1912 | Advanced Construction Techniques | PE | 3 | 0 | 0 | 3 | 3 |
| 4. | 21CE1911 | Construction Management and Safety | PE | 3 | 0 | 3 | 3 | 3 |
| 5. | 21CE1910 | Sustainable Construction and Lean Construction | PE | 3 | 0 | 0 | 3 | 3 |
| 6. | 21CE1913 | Energy Efficient Buildings | PE | 3 | 0 | 0 | 3 | 3 |
| 7. | 21CE1914 | Digitalized Construction Lab | PE | 3 | 0 | 0 | 3 | 3 |

### VERTICAL III: GEO TECHNICAL

| S. NO. | COURSECODE | COURSE TITLE | CATEGORY | PERIODS PERWEEK | | | TOTAL CONTACT PERIODS | CREDITS |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | |
| 1. | 21CE1915 | Geo- | PE | 3 | 0 | 0 | 3 | 3 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Environmental Engineering | | | | | | |
| 2. | 21CE1916 | Ground Improvement Techniques | PE | 3 | 0 | 0 | 3 | 3 |
| 3. | 21CE1917 | Soil Dynamics and Machine Foundations | PE | 3 | 0 | 0 | 3 | 3 |
| 4. | 21CE1918 | Rock Mechanics | PE | 3 | 0 | 0 | 3 | 3 |
| 5. | 21CE1919 | Earth and Earth Retaining Structures | PE | 3 | 0 | 0 | 3 | 3 |
| 6. | 21CE1920 | Pile Foundation | PE | 3 | 0 | 0 | 3 | 3 |
| 7. | 21CE1921 | Tunneling Engineering | PE | 3 | 0 | 0 | 3 | 3 |

## VERTICAL IV: GEO-INFORMATICS

| S. NO. | COURSE CODE | COURSE TITLE | CATEGORY | PERIODS PERWEEK | | | TOTAL CONTACT PERIODS | CREDITS |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | |
| 1. | 21CE1922 | Total Station and GPS Surveying | PE | 3 | 0 | 0 | 3 | 3 |
| 2. | 21CE1923 | Remote Sensing Concepts | PE | 3 | 0 | 0 | 3 | 3 |
| 3. | 21CE1924 | Satellite Image Processing | PE | 3 | 0 | 0 | 3 | 3 |
| 4. | 21CE1925 | Cartography and GIS | PE | 3 | 0 | 0 | 3 | 3 |
| 5. | 21CE1926 | Photogrammetry | PE | 3 | 0 | 0 | 3 | 3 |
| 6. | 21CE1927 | Hydrographic Surveying | PE | 3 | 0 | 0 | 3 | 3 |
| 7. | 21CE1928 | Airborne and Terrestrial Laser Mapping | PE | 3 | 0 | 0 | 3 | 3 |

## VERTICAL V: TRANSPORTATION INFRASTRUCTURE

| S. NO. | COURSE CODE | COURSE TITLE | CATEGORY | PERIODS PERWEEK | | | TOTAL CONTAT PERIODS | CREDITS |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | |
| 1. | 21CE1929 | Traffic Engineering and Management | PE | 3 | 0 | 0 | 3 | 3 |
| 2. | 21CE1930 | Urban Planning and Development | PE | 3 | 0 | 0 | 3 | 3 |
| 3. | 21CE1931 | Smart Cities | PE | 3 | 0 | 0 | 3 | 3 |
| 4. | 21CE1932 | Intelligent Transport Systems | PE | 3 | 0 | 0 | 3 | 3 |
| 5. | 21CE1933 | Pavement Engineering | PE | 3 | 0 | 0 | 3 | 3 |
| 6. | 21CE1934 | Transportation Planning Process | PE | 3 | 0 | 0 | 3 | 3 |
| 7. | 21CE1935 | Airports and Harbours | PE | 3 | 0 | 0 | 3 | 3 |

## VERTICAL VI: ENVIRONMENT

| S. NO. | COURSE CODE | COURSE TITLE | CATEGORY | PERIODS PER WEEK | | | TOTAL CONTACT PERIODS | CREDITS |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | |
| 1. | 21CE1936 | Air and Noise Pollution Control Engineering | PE | 3 | 0 | 0 | 3 | 3 |
| 2. | 21CE1937 | Environmental Impact Assessment | PE | 3 | 0 | 0 | 3 | 3 |
| 3. | 21CE1938 | Industrial Wastewater Management | PE | 3 | 0 | 0 | 3 | 3 |
| 4. | 21CE1939 | Solid and Hazardous Waste Management | PE | 3 | 0 | 0 | 3 | 3 |
| 5. | 21CE1940 | Environmental Policy and Legislations | PE | 3 | 0 | 0 | 3 | 3 |
| 6. | 21CE1941 | Environment, Health and Safety | PE | 3 | 0 | 0 | 3 | 3 |
| 7. | 21CE1942 | Climate Change Adaptation and Mitigation | PE | 3 | 0 | 0 | 3 | 3 |

## VERTICAL VII: WATER RESOURCES

| S. NO. | COURSE CODE | COURSE TITLE | CATEGORY | PERIODS PERWEEK | | | TOTAL CONTACT PERIODS | CREDITS |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | |
| 1. | 21CE1943 | Participatory Water Resources Management | PE | 3 | 0 | 0 | 3 | 3 |
| 2. | 21CE1944 | Ground Water Engineering | PE | 3 | 0 | 0 | 3 | 3 |
| 3. | 21CE1945 | Water Resources Systems Engineering | PE | 3 | 0 | 0 | 3 | 3 |
| 4. | 21CE1946 | Watershed Conservation and Management | PE | 3 | 0 | 0 | 3 | 3 |
| 5. | 21CE1947 | Integrated Water Resources Management | PE | 3 | 0 | 0 | 3 | 3 |
| 6. | 21CE1948 | Water Quality and Management | PE | 3 | 0 | 0 | 3 | 3 |
| 7. | 21CE1949 | Urban Water Infrastructure | PE | 3 | 0 | 0 | 3 | 3 |

## VERTICAL VIII: OCEAN ENGINEERING

| S. NO | COURSECODE | COURSE TITLE | CATEGORY | PERIODS PER WEEK | | | TOTAL CONTACT PERIODS | CREDITS |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | |
| 1. | 21CE1950 | Marine Geo-Technical Engineering | PE | 3 | 0 | 0 | 3 | 3 |
| 2. | 21CE1951 | Coastal Engineering | PE | 3 | 0 | 0 | 3 | 3 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 3. | 21CE1952 | Off-shore Structures | PE | 3 | 0 | 0 | 3 | 3 |
| 4. | 21CE1953 | Port and Harbour Engineering | PE | 3 | 0 | 0 | 3 | 3 |
| 5. | 21CE1954 | Coastal Hazards and Mitigation | PE | 3 | 0 | 0 | 3 | 3 |
| 6. | 21CE1955 | Coastal Zone Management and Remote Sensing | PE | 3 | 0 | 0 | 3 | 3 |
| 7. | 21CE1956 | Ocean Wave Dynamics | PE | 3 | 0 | 0 | 3 | 3 |

## VERTICAL IX: DIVERSIFIED COURSES

| S. NO. | COURSE CODE | COURSE TITLE | CATE GORY | PERIODS PERWEEK | | | TOTAL CONTACT PERIODS | CREDITS |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | | |
| 1. | 21CE1957 | Steel Concrete Composite Structures | PE | 3 | 0 | 0 | 3 | 3 |
| 2. | 21CE1958 | Finance for Engineers | PEC | 3 | 0 | 0 | 3 | 3 |
| 3. | 21CE1959 | Earth and Rock fill Dams | PEC | 3 | 0 | 0 | 3 | 3 |
| 4. | 21CE1960 | Rainwater Harvesting | PEC | 3 | 0 | 0 | 3 | 3 |
| 5. | 21CE1961 | Transport and Environment | PEC | 3 | 0 | 0 | 3 | 3 |
| 6. | 21CE1962 | Environmental Quality Monitoring | PEC | 3 | 0 | 0 | 3 | 3 |
| 7. | 21CE1963 | Computational Fluid Dynamics | PEC | 3 | 0 | 0 | 3 | 3 |

## Semester Wise Credit Distribution in the Proposed Curriculum

| S.No. | Subject Area | Credits Per Semester | | | | | | | | Credits Total | Percentage % |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Semester | I | II | III | IV | V | VI | VII | VIII | | |
| 1. | Humanities and Social Studies (HS) | 4 | 4 | | | 3 | | 3 | | 14 | 8.139 |
| 2. | Basic Sciences (BS) | 12 | 7 | 4 | 3 | | | | | 26 | 13.37 |
| 3. | Engineering Sciences (ES) | 9 | 9 | | | | | | | 18 | 10.46 |
| 4. | Professional Core (PC) | | 2 | 16 | 21 | 16 | 10 | 8 | | 73 | 44.80 |
| 5. | Professional Electives (PE) | | | | | 3 | 6 | 6 | 6 | 21 | 12.20 |
| 6. | Open Electives (OE) | | | | | | 3 | 3 | | 6 | 3.5 |
| 7. | Project Work (PR/EEC) | | | | | | 4 | 2 | 8 | 14 | 8.13 |
| 8. | Non-Credit/ (Mandatory) | | 0 | 0 | | | | | | | |
| | Total | 25 | 22 | 20 | 24 | 22 | 23 | 22 | 14 | 172 | 100 |

| 21HS1101 | COMMUNICATIVE ENGLISH& LANGUAGE SKILLS LAB I INTEGRATED | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 2 | 4 |

**OBJECTIVES:**

- To induce the basic reading and writing skills among the first-year engineering and technology students.
- To assist the learners to develop their listening skills, which will enable them listening to lectures and comprehend them by asking questions and seeking clarifications
- To succor the learners to develop their speaking skills and speak fluently in real contexts.
- To motivate the learners to develop vocabulary of a general kind by developing their reading skills for meeting the competitive exams like GATE, TOFEL, GRE, IELTS, and other exams conducted by Central and State governments.

**UNIT - I INTRODUCING ONESELF 9**

Listening: Listening and filling details, Listening to Speeches by Specialists and Completing Activities such as Answering Questions, Identifying the Main Ideas, Style, etc. Speaking: Introducing Oneself – Introducing Friend/ Family. Reading: Descriptive Passages (From Newspapers / Magazines). Writing: Writing a Paragraph (Native Place, School Life), Developing Hints. Grammar: Noun, Pronoun & Adjective. Vocabulary Development: One Word Substitution

**UNIT - II DIALOGUE WRITING 9**

Listening: Listening to Conversations (Asking for and Giving Directions). Speaking: Making Conversation Using (Asking for Directions, Making an Enquiry), Role Plays, and Dialogues. Reading: Reading a Print Interview and Answering Comprehension Questions. Writing: Writing a Checklist, Dialogue Writing Grammar: Tenses and Voices. Vocabulary Development: Prefix &Suffix, Word formation.

**UNIT - III DRAFTING OFFICIAL COMMUNICATIONS 9**

Listening: Listening for specific information. Speaking: Giving Short Talks on a given Topic. Reading: Reading Motivational Essays on Famous Engineers and Technologists (Answering Open – Ended and Closed Questions).Writing: Writing Formal Letters / Emails. Grammar: Adverb, Prepositions & Conjunctions. Vocabulary Development: Collocations – Fixed Expressions.

**UNIT -IV WRITTEN COMMUNICATION 9**

Listening: Listening to Short Talks (5 Minutes Duration and Fill a Table, Gap-Filling Exercise) Note Taking/Note Making .Speaking: Small Group Discussion, Giving Recommendations .Reading: Reading Problem – Solution Articles/Essays Drawn From Various Sources .Writing: Making Recommendations Note Making – Complaint Letters. Grammar: Subject-Verb Agreement, Framing Questions. Vocabulary Development: Connectives, Reference Words, Technical Vocabulary.

**UNIT -V WRITING DEFINITIONS AND PRODUCT DESCRIPTION 9**

Listening: Listening to a Product Description (Labeling and Gap Filling) Exercises. Speaking: Describing a Product and Comparing and Contrasting it with Other Products. Reading: Reading Graphical Material for Comparison (Advertisements).Writing: Writing Definitions (Short and Long) – Compare and Contrast Paragraphs, Essay writing. Grammar:– Phrasal Verbs – Cause and Effect Sentences –Compound Nouns Vocabulary Development: Use of Discourse Markers.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

1. The students will be able to comprehend conversations and short talks delivered in English
2. Participate effectively in informal conversations; introduce themselves and their friends and express opinions English
3. Read articles of a general kind in magazines and newspapers
4. Write short essays of a general kind and personal letters and emails in English
5. Recognize the use of grammar in speech and writing

**TEXT BOOKS:**

1. N P Sudharshana& C Savitha. *English for Technical Communication* Delhi: CUP, 2019.
2. Board of Editors. *English for Engineers and Technologists* Volume 1 Orient Black Swan Limited, 2020.

**REFERENCES:**

1. Board of Editors. Using English-A course book for Undergraduate engineers and Technologists Orient Black SwanLimited, 2017
2. Bailey, Stephen. Academic Writing: *A Practical Guide for Students*. New York: Rutledge, 2011. 3.Comfort, Jeremy, et al. *Speaking Effectively: Developing Speaking Skills for Business English*. CambridgeUniversity Press, Cambridge: Reprint 2011
3. Means,L. Thomas and Elaine Langlois. *English & Communication For Colleges*. Cengage Learning ,USA:2007
4. Redston, Chris & Gillies Cunningham *Face2Face* (Pre-intermediate Student's Book& Workbook)Cambridge University Press, New Delhi: 2005.

**WEB REFERENCES:**

1. https://learnenglishteens.britishcouncil.org/exams/grammar-and-vocabulary-exams/word-formation
2. https://cdn.s3waas.gov.in/s347d1e990583c9c67424d369f3414728e/uploads/2018/02/2018031621.pdf
3. http://xn--englishclub-ql3f.com/grammar/parts-of-speech.htm
4. https://www.edudose.com/english/grammar-degree-of-comparison-rules/

**ONLINE COURSES / RESOURCES:**

1. https://basicenglishspeaking.com/wh-questions/
2. https://agendaweb.org/verbs/modals-exercises.html
3. https://cdn.s3waas.gov.in/s347d1e990583c9c67424d369f3414728e/uploads/2018/02/2018031621.pdf
4. https://www.ego4u.com/en/cram-up/grammar/prepositions

**LANGUAGE SKILLS LAB**

**List of exercises** **MINIMUM OF EXERCISES TO BE CONDUCTED** **15**

1. Reading: Different text type
2. Reading: Predicting content using pictures and title.
3. Reading: Use of graphic organizers to review
4. Reading: Aid comprehension.
5. Reading: Understanding reference words
6. Reading: Use of connectors in a passage-
7. Reading: Speed reading Techniques.
8. Reading and Comprehending the passages in the competitive exams like GATE, TOFEL, GRE,IELTS, and other exams conducted by Central and State governments.

9. Reading: Sentence Completion: Exercises used in competitive exams.
10. Writing- Error Detection:
11. Writing-Spotting and reasoning the errors found from the passages in competitive exams.
12. Writing-Email writing
13. Writing: Job Application: Resume
14. Writing- Elements of a good essay-
15. Writing: Types of essays- Descriptive-Narrative- issue based.
16. Writing: Statement of Purpose
17. Writing: Letter of recommendation
18. Writing: Vision statement
19. Writing- Verbal Analogy,
20. Writing- Phrases, and Idioms associated with competitive exams.

**TOTAL: 30 PERIODS**

**SOFTWARE REQUIRED:**

Globarena

**REFERENCS**


1. SureshKumar.E and et al. Enriching Speaking and Writing Skills. Second Edition. Orient Black swan: Hyderabad, 2012
2. Davis, Jason and Rhonda Liss. Effective Academic Writing (Level 3) Oxford University Press: Oxford, 2006
3. Withrow, Jeans and et al. Inspired to Write. Readings and Tasks to develop writing skills. Cambridge UniversityPress: Cambridge, 2004
4. Goatly, Andrew. Critical Reading and Writing. Routledge: United States of America, 2000

| 21MA1101 | ENGINEERING MATHEMATICS- I | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 1 | 0 | 4 |

**OBJECTIVES:**

- Matrix transforms are very useful within the world of computer graphics. A matrix algebra can be readily applied to the structural properties of graphs from an algebraic point of view.
- The aim of this course to get depth knowledge about calculus.
- Familiarize the functions of two variables and finding its extreme points.
- To make the students understand various techniques of integration.
- Apply multiple integral ideas in solving areas, volumes and other practical problems

**UNIT – I MATRICES 9+3**

Eigen values and Eigen vectors of a real matrix —Rank of the matrix – Characteristic equation — Properties of Eigenvalues and Eigen vectors — Cayley Hamilton theorem — Diagonalization of matrices— Reduction of a quadratic form to canonical form by orthogonal transformation and similarity transformation —Nature of quadratic forms.

**UNIT – II DIFFERENTIAL CALCULUS 9+3**

Representation of functions – Limit of a function – Continuity – Derivatives – Differentiation rules (Sum, Product & Quotient rule, Chain rule, logarithmic and implicit differentiation) – Maxima and Minima of functions of one variable-Rolle's theorem- Mean value theorem.

**UNIT – III FUNCTIONS OF SEVERAL VARIABLES 9+3**

Partial differentiation – Homogeneous functions and Euler's theorem – Total derivative – Change of variables – Jacobians – Partial differentiation of implicit functions – Taylor's series for functions of two variables – Maxima and minima of functions of two variables –Lagrange's method of undetermined multipliers.

**UNIT –IV INTEGRAL CALCULUS 9+3**

Definite and Indefinite integrals – Substitution rule – Techniques of Integration – Integration by parts – Bernoulli's formula- Trigonometric integrals – Trigonometric substitutions – Integration of rational functions by partial fraction – Integration of irrational functions – Improper integrals.

**UNIT –V MULTIPLE INTEGRALS 9+3**

Double integrals in modelling and polar coordinates – Change of order of integration in modelling coordinates– Area enclosed by plane curves – Change of variables in double integrals – Triple integrals –Volume of Solids.

**TOTAL: 60 PERIODS**

**OUTCOMES:**

1. Able to find eigenvalues and eigen vectors, diagonalization of a matrix, symmetric matrices, positive definite matrices and similar matrices.
2. Apply limit definition and rules of differentiation to differentiate functions.
3. Understand familiarity in the knowledge of Maxima and Minima, Jacobian, Taylor series and apply the problems involving Science and Engineering
4. Understand the knowledge of Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction.
5. Understand the knowledge of Area enclosed byplane curves, Change of variables in double integrals, Triple integrals, Volume of Solids.

**TEXT BOOKS:**

1. Grewal B.S., ―Higher Engineering Mathematics‖, Khanna Publishers, NewDelhi,43rdEdition, 2014.
2. James Stewart, -Calculus: Early Transcendentals‖, Cengage Learning,7thEdition, NewDelhi, 2015.
3. Bali N., Goyal M. and Walkins C., ―Advanced Engineering Mathematics‖, Firewall Media (An imprint of Lakshmi Publications Pvt. Ltd.,), New Delhi, 7th Edition, 2009

**REFERENCES:**


1. Anton, H, Bivens, I and Davis, S, -Calculus‖, Wiley, 10th Edition, 2016.
   Jain R.K. and Iyengar S.R.K., ―Advanced Engineering Mathematics‖, Narosa
2. Publications,NewDelhi, 3rd Edition, 2007.
   Narayanan, S. and Manicavachagom Pillai, T. K., –Calculus‖ Volume I and II, S. Viswanathan
3. Publishers Pvt. Ltd., Chennai, 2007
4. Srimantha Pal and Bhunia, S.C, -Engineering Mathematics‖ Oxford University Press, 2015.
5. Weir, M.D and Joel Hass, -Thomas Calculus‖, 12th Edition, Pearson India, 2016.
6. B.V. Ramana, ― Higher Engineering Mathematics‖, McGraw Hill Education, India.
7. Erwin Kreyzig, Advanced Engineering Mathematics, John Wiley sons,10thedition,2015


**ONLINE COURSES / RESOURCES:**

1. https://onlinecourses.nptel.ac.in/noc21_ma60/preview
   https://onlinecourses.nptel.ac.in/
   noc21_ma58/preview

| 21PH1101 | ENGINEERING PHYSICS | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**OBJECTIVES:**

- To enhance the fundamental knowledge in Physics and its applications relevant to various streams of Engineering and Technology.

**UNIT – I MECHANICS 9**

System of particles: centre of mass in one and two dimensions – rotational motion of continues system – torque – moment of inertia – conservation of angular momentum – Newton's laws for rotation – equations of rotational motion – work energy theorem for rotational motion. Stress, strain, Hooke's law and elastic moduli – twisting couple per unit twist for solid and hollow cylinders – torsional pendulum theory – bending moment of beam – cantilever and non-uniform bending theory – uniform bending theory – I shape girder.

**UNIT – II ELECTROMAGNETIC THEORY 9**

Divergence – curl – integral calculus – Gauss divergence theorem – Stoke's theorem – equation of continuity – displacement current – Maxwell's equations – Gauss's laws – Faraday's law –Ampere-Maxwell law – mechanism of electromagnetic wave propagation – Hertz observation – production and detection of electromagnetic wave – electromagnetic waves in free space and matter – energy carried by electromagnetic wave – momentum and radiation pressure – properties of electromagnetic waves.

**UNIT – III THERMAL PHYSICS 9**

Mode of heat transfer: conduction, convection and radiation – thermal expansion of solids – bimetallic strips – thermal conductivity – heat conduction through compound media (series & parallel) – Forbe's and Lee's disc method; theory and experiment – thermal insulation – applications – heat exchangers – refrigerators, solar water heater.

**UNIT –IV OSCILLATORY MOTION, LASERS AND FIBER OPTICS 9**

Spring mass system – differential equation-simple harmonic motion-damped oscillation-forced oscillation –analogy with LCR circuits and mechanical oscillation – plane wave equation – equations of wave motion in a rope and velocity of wave. Population of energy levels, Einstein's A and B coefficients derivation – optical amplification (qualitative) – Semiconductor lasers: homojunction and heterojunction –components and principle of fiber optics – numerical aperture and acceptance angle derivation – types of optical fibers (material, refractive index, mode) – losses associated with optical fibers – fiberas pressure and displacement sensors.

**UNIT –V QUANTUM MECHANICS 9**

Blackbody radiation – Planck's hypothesis and derivation – wave particle duality of light: concepts of photon – Compton effect: theory and experiment – de Broglie hypotheses - concept of wave function and its physical significance – Schrödinger's wave equation – time independent and time dependent equations – particle in a one-dimensional box – tunnelling (qualitative) – scanning tunnelling microscope.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

1. Upon completion of this course, the students will understand the basics of mechanics and especially elastic properties of materials.
2. Upon completion of this course, the students will gain knowledge on the basic concepts of electromagnetic waves and its properties.
3. Upon completion of this course, the students will have adequate knowledge on the concepts of thermal properties of materials and their applications in heat exchangers
4. Upon completion of this course, the students will acquire knowledge on the concepts of oscillations, lasers and fiber optics and their technological applications
5. Upon completion of this course, the students will get knowledge on advanced physics concepts of quantum theory and its applications in modelling microscopes.

**TEXT BOOKS:**


1. Gaur, R.K. & Gupta, S.L. -Engineering Physics‖. Dhanpat Rai Publishers, 2012.
2. Santhosam, K. Russel Raj, K. & Maheswaran, A. ―Engineering Physics, KRAM Publications, 2021
3. Pandey, B.K. & Chaturvedi, S. ―Engineering Physics‖. Cengage Learning India, 2012.


**REFERENCES:**


1. Halliday, D., Resnick, R. & Walker, J. ―Principles of Physics‖. Wiley, 2015.
2. Tipler, P.A. & Mosca, G. ―Physics for Scientists and Engineers with Modern Physics'. W.H.Freeman, 2007.
3. Arthur Beiser, ―Concepts of Modern Physics‖, Mc Graw Hill, Sixth edition, 1994.
4. Douglas. C., Giancoli. ―Physics: Principles with applications‖, Pearson, 2014.


**WEB REFERENCES:**

1. https://kluniversity.in/physics/pdfs/crypdf.pdf
2. https://mrcet.com/downloads/digital_notes/ECE/III%20Year/FIBER%20OPTICAL%20COMMUNICATIONS.pdf
3. https://nptel.ac.in/content/storage2/courses/117101002/downloads/Lec01.pdf
4. https://nptel.ac.in/content/storage2/courses/117101002/downloads/Lec19.pdf
5. https://ocw.mit.edu/courses/physics/8-04-quantum-physics-i-spring-2016/lecture-notes/MIT8_04S16_LecNotes3.pdf
6. https://ocw.mit.edu/courses/physics/8-04-quantum-physics-i-spring-2016/lecture-notes/MIT8_04S16_LecNotes5.pdf

**ONLINE COURSES / RESOURCES:**

1. https://nptel.ac.in/courses/115/102/115102023/
2. https://nptel.ac.in/courses/115/106/115106066/

| 21CY1101 | ENGINEERING CHEMISTRY | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**OBJECTIVES:**

- To know about the importance of Chemistry in Engineering domain
- To understand the Chemistry background of industrial process.
- To apply Chemistry knowledge for Engineering disciplines.

**UNIT – I WATER TECHNOLOGY 9**

Hardness –Types of hardness – Estimation by EDTA method – Boiler troubles- scale, sludge, priming, foaming, caustic embrittlement, Boiler corrosion – Internal Conditioning – Carbonate, phosphate, Calgon conditioning – External Conditioning – Zeolite and Demineralization process – Desalination, Reverse Osmosis Method – Domestic water treatment.

**UNIT – II HIGH POLYMERS AND NANOCHEMISTRY 9**

**Polymers** – Introduction – Classification of Polymers (Origin/Source, Structure, Monomers, Inter-molecular Forces, Synthesis) – Commercial Polymers (Poly Vinyl Chloride (PVC), Polytetrafluoroethylene (PTFE), Nylon-6 6, Nylon-6, Polyethylene Terephthalate (PET) – Conducting Polymers – Polyaniline, Polythiophene, Trans-Polyacetylene – Basic definition – FRP – General Engineering applications of FRP (Civil Engineering Structures).**Nanomaterials –** Introduction, size dependent properties (Surface area, Electrical, Optical, Catalytic and Thermal properties). Synthesis of nanomaterials: Top-down and bottom-up approaches, Chemical Synthesis – Co precipitation, Sol-Gel process and Chemical vapor deposition, Nanoscale materials: Fullerenes, Carbon nanotubes and 8odellin – Characterization, properties and applications. Green synthesis of Nanoparticles.

**UNIT – III INSTRUMENTAL METHODS AND ANALYSIS 9**

Introduction to Spectroscopy – Types of spectroscopy – Absorption spectra – Emission spectra – Wave length and Wave number- Electromagnetic radiation – Flame Photometry, Atomic Absorption Spectroscopy, UV-Visible spectrum. Introduction – basic principles – Instrumentation& Applications – Infrared Spectroscopy. Chromatographic methods – Types (column, Thin layer, paper, Gas, High Performance Liquid Chromatographic methods) – principle- Separation and quantification of Organic compounds by GC and HPLC. Conductometric Titrations: Instrumentation – Advantages – Applications Potentiometric Titrations: Instrumentation –Advantages-Applications. Measurement of pH: pH metry – Instrumentation – Applications.

**UNIT –IV ELECTROCHEMISTRY AND CORROSION 9**

Introduction- Electrode potentials-Electrochemical series-Electrochemical cell-redox reaction – measurement and applications – Nernst Equation Derivation- Electrochemical extraction of metals – Electrolytic refining of metals –Nano electrochemical Sensors. Corrosion – causes, factors, types, Chemical and Electrochemical Corrosion (Galvanic, Differential aeration) – Corrosion Control, Electrochemical protection – Sacrificial Anodic method – Impressed Current Cathodic Protection – Corrosion Inhibitors – Biocorrosion.Protective Coatings – Paints, Constituents, Functions- Surface preparation for metallic coatings, Electroplating and Electroless Plating.

**UNIT –V ENERGY SOURCES AND STORAGE DEVICES 9**

Introduction – Nuclear energy – Nuclear fission – Controlled Nuclear fission – Nuclear Fusion – Differences – Nuclear chain reactions –Nuclear Reactor – Classification of Nuclear Reactor – Light WaterNuclear Reactor, Breeder Reactor – Solar Energy, Conversion, Solar Cells – Wind Energy.
Batteries and Fuel Cells – Types of batteries — Zinc – carbon dry cell –Lead Storage battery– Nickel-Cadmium Battery – Lithium battery – Battery Engineering – Battery hazards – Biological Batteries.Fuel Cells – Hydrogen-Oxygen Fuel Cell – Hondas cell- Supercapacitors (elementary idea)

**TOTAL: 45 PERIODS**

**OUTCOMES:**

1. Analyze the water quality parameters in purification and significance in industries, daily life.
2. Explain the types, fabrication and engineering applications of polymers. Develop economically nemethods of synthesizing nano materials and their applications.
3. Demonstrate the knowledge of analytical techniques using spectroscopy.
4. Relate the electrode potential for its feasibility in electrochemical reaction. Illustrate the causes, cocorrosion and to achieve its protection.
5. Compare the economic and efficient usage of non-conventional and conventional energy sourceand various storage devices.

**TEXT BOOKS:**


1. P.C.Jain and Monika Jain, ―Engineering Chemistry‖, Dhanpat Rai Publishing Company(P) LTD., New Delhi.
2. S. S. Dara and S.S. Umare, ―A Textbook of Engineering Chemistry‖ S. Chand and Company Ltd, New Delhi.
3. V.R.Gowariker, N.V.Viswanathan and JayadevSreedhar, ―Polymer Science‖, New Age International P (Ltd.,), Chennai, 2006
4. P. Kannan and A. Ravikrishnan, ―Engineering Chemistry‖, Sri Krishna Hitech Publishing Company Pvt. Ltd. Chennai, 2009. 16
5. S. Vairam, P. Kalyani and Suba Ramesh, ―Engineering Chemistry‖, Wiley India, 2011


**REFERENCES:**


1. Friedrich Emich, ―Engineering Chemistry‖, Scientific International Pvt. Ltd., NewDelhi.
2. PrasanthaRath, ―Engineering Chemistry‖, Cengage Learning India Pvt., Ltd., Delhi.
3. P.W. Atkins and de Paula Julio, ―Physical Chemistry‖, Oxford University Press, 8th Ed.,(Indian Student Edition) (2009).
4. K. K. Rohatgi-Mukherjee, ―Fundamental of Photochemistry‖ New Age International (P) Ltd., New Delhi, 1986.
5. G.A. Ozin and A.C. Arsenault, ―Nanochemistry: A Chemical Approach toNanomaterials‖, RSC Publishing, 2005 Nanomaterials, B.Viswanathan, Alpha Science , ISBN: 9781842654941


**WEB REFERENCES:**

http://www.mhhe.com/engcs/compsci/forouzan/dcn/student/olc

**ONLINE COURSES / RESOURCES:**

1. https://nptel.ac.in/courses/103/108/103108100
2. https://nptel.ac.in/courses/121/106/121106014
3. https://nptel.ac.in/courses/104/105/104105039

| 21ES1101 | PROBLEM SOLVING AND PYTHON PROGRAMMING | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**OBJECTIVES**

- To know the basic programming constructs –data types, decision structures, and control structures in python
- To know how to use libraries for string manipulation
- To Use python data structures – Lists, Tuples and Dictionary
- To know the basic concepts of Object-Oriented Programming
- To learn about input/output with files in Python.

**UNIT – I ALGORITHMIC PROBLEM SOLVING 9**

Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language); Python: Data types, variables, expressions, precedence of operators, algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, and guess an integer number in a range, Towers of Hanoi.

**SUGGESTED ACTIVITIES:**

- Developing Pseudo codes and flowcharts for real life activities such as railway ticket Booking using IRCTC, admission process to undergraduate course, academic schedules during a semester etc.
- Developing algorithms for basic mathematical expressions using arithmetic Operations
- Installing Python.
- Simple programs on print statements, arithmetic operations.

**SUGGESTED EVALUATION METHODS:**

- Quizzes on algorithm and basic python.
- Assignments on illustrative problems.
- Quizzes on simple python programs.

**UNIT – II CONTROL FLOW, STRINGS & FUNCTIONS 9**

Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; functions, function definition and use; Fruitful functions: return values, parameters and arguments, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, stringmodule. Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.

**SUGGESTED ACTIVITIES:**

- Simple Python program implementation using Operators, Conditionals, Iterative Constructs and Functions
- Developing simple applications like calculator, calendar, phone directory, to-do lists etc.
- Flow charts for GCD, Exponent Functions, Fibonacci Series using conditionals and
- Recursion vs. Iteration.

**SUGGESTED EVALUATION METHODS:**

- Quizzes on strings.
- Assignments on illustrative problems.
- Quizzes on control flow and functions.

**UNIT – III LISTS, TUPLES, DICTIONARIES 9**

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing – list comprehension; Lists as arrays. Illustrative programs: selection sort, insertion sort, merge sort, histogram.

**SUGGESTED ACTIVITIES:**

- Implementing python program using lists, tuples, sets for the following scenario:

- Simple sorting techniques
- Student Examination Report
- Billing Scheme during shopping.
- Implementing any application using List and Tuple data structures.

**SUGGESTED EVALUATION METHODS:**

- Quizzes on list slices.
- Assignments on illustrative problems.
- Quizzes on tuples and dictionaries.

**UNIT – IV OBJECT ORIENTED PROGRAMMING WITH PYTHON 9**

Classes and OOP: classes, objects, attributes and methods; defining classes; design with classes, data 11odelling; persistent storage of objects – inheritance, polymorphism, operator overloading; abstract classes; exception handling, try block. Illustrative programs: demonstrate the concept of class and objects.

**SUGGESTED ACTIVITIES:**

- Features of OOP.
- Persistent storage of objects
- Operators and its usage.
- Simple programs using OOP concepts.

**SUGGESTED EVALUATION METHODS:**

- Quizzes on basic OOP concepts.
- Assignments on illustrative problems.
- Quizzes on inheritance and exception handling.

**UNIT – V FILES, MODULES, PACKAGES 9**

Files and exception: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file.

**SUGGESTED ACTIVITIES:**

- Developing modules using Python to handle files and apply various operations on files
- Usage of exceptions, multiple except blocks – for applications that use delimiters likeage, range of numerals etc.
- Implementing Python program to open a non-existent file using exceptions.

**SUGGESTED EVALUATION METHODS:**

- Quizzes on basic file operations.
- Assignments on illustrative problems.
- Quizzes on packages and modules.

**TOTAL: 45 PERIODS**

**OUTCOME:**

1. Develop algorithmic solutions to simple computational problems.
2. Write and execute simple Python programs.
3. Familiarize with python string handling techniques and user defined functions.
4. Represent compound data using Python lists, tuples and dictionaries.
5. Understand the concept of object oriented programming techniques.
6. Read and write data from/to files in Python Programs.

**TEXT BOOKS:**

1. Reema Thareja, ``Problem Solving and Programming with Python'', 2nd edition, OXFORD University Press, New Delhi, 2019.(UNIT 1,2,3,4(Exception Handling) and 5).

2. Bill Lubanovic, ―Introducing Python-Modern Computing in Simple Package‖, 2nd edition, O'REILLY, 2019.(UNIT 4(Object Oriented Programming)).

**REFERENCES:**

1. Steven F. Lott, -Modern Python Cookbook'', 2nd Edition, O'REILLY, 2020.
2. Ryan Marvin, Mark Ng'ang'a, Amos Omondi, ―Python Fundamentals, Packt Publishing., 2018.
3. Paul J. Deitel, Python for Programmers, Pearson India Education Services Pvt. Ltd,2020.
4. Martin C. Brown, Python: The Complete Reference, McGraw Hill Education; Forth edition, 2018.

**WEB REFERENCES:**

1. https://greenteapress.com/thinkpython2/thinkpython2.pdf
2. https://freecomputerbooks.com/An-Introduction-to-Python-Guido-van-Rossum.html#downloadLinks
3. http://marvin.cs.uidaho.edu/Teaching/CS515/pythonTutorial.pdf

**ONLINE COURSES / RESOURCES:**

1. https://docs.python.org/3/tutorial/
2. https://www.w3schools.com/python/
3. https://www.tutorialspoint.com/python/index.htm
4. https://www.javatpoint.com/python-tutorial
5. https://nptel.ac.in/courses/

| 21ES1102 | ENGINEERING GRAPHICS | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 2 | 4 |

**OBJECTIVES:**

- Drawing free hand sketches of basic geometrical shapes and multiple views of objects.
- Drawing orthographic projections of lines and planes.
- Drawing orthographic projections of solids.
- Drawing development of the surfaces of objects.
- Drawing isometric and perspective views of simple solids.

**CONCEPTS AND CONVENTIONS (Not for Examination): 2**

Importance of graphics in engineering applications – Use of drafting instruments. BIS conventions and specifications. Size, layout and folding of drawing sheets – Lettering and dimensioning. Introduction to drafting packages like CAD and demonstration of their use in engineering fields.

**UNIT – I PLANE CURVES AND FREEHAND SKETCHING 14**

Basic Geometrical constructions, Curves used in engineering practices-Conics: Construction of Ellipse, Parabola and Hyperbola by eccentricity method – Construction of cycloid, Involutes of square, pentagon and circle – Drawing of tangents and normal to the above curves. Free Hand sketching-Orthographic projection – Orthographic views of simple three-Dimensional objects.

**UNIT – II PROJECTION OF POINTS, LINES AND PLANE SURFACES 15**

Orthographic projection- principles-Principle planes-First angle projection-Projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes-Determination of true lengths eg and true inclinations by rotating line method and traces. Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

**UNIT – III PROJECTION OF SOLIDS 15**

Projection of simple solids like prisms, pyramids, cylinder, and cone when the axis is inclined to one principle planes by rotating object method and auxiliary plane method.

**UNIT –IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES 15**

Sectioning of solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple solids and frustum and truncated solids – Prisms, pyramids cylinders and cones.

**UNIT –V ISOMETRIC AND PERSPECTIVE PROJECTIONS 14**

Principles of isometric projection – isometric scale –Isometric projections of simple solids and frustum and truncated solids – Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions. Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method.

**TOTAL: 75 PERIODS**

**OUTCOMES:**

1. Draw free hand sketching of basic geometrical shapes and multiple views of objects.
2. Draw orthographic projections of lines and planes
3. Draw orthographic projections of solids
4. Draw development of the surfaces of objects
5. Draw isometric and perspective views of simple solids.

**TEXT BOOKS:**

1. Natarajan, K. V., ―A text book of Engineering Graphics‖, 28th Ed., Dhanalakshmi Publishers, Chennai, 2015.
2. Venugopal, K. and Prabhu Raja, V., ―Engineering Graphics‖, New Age, 2008.

**REFERENCES:**

1. Bhatt, N.D.,Panchal V M and Pramod R. Ingle, ―Engineering Drawing‖, Charotar Publishing House, 53rd Edition, 2014.
2. Parthasarathy, N. S. and Vela Murali, ―Engineering Drawing‖, Oxford University Press, 2015
3. Agrawal, B. and Agrawal C.M., -Engineering Drawing‖, Tata McGraw, N.Delhi, 2008.

**WEB REFERENCES:**

1. https://nptel.ac.in/courses/105/104/105104148/
2. https://www.youtube.com/channel/UCkCk0nvNyWhEOLge9JtDLDg

**ONLINE COURSES / RESOURCES:**

1. https://nptel.ac.in/courses/112/103/112103019/

| 21ES1111 | PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 4 | 2 |

**OBJECTIVES:**

- To write, test, and debug simple Python programs.
- To implement Python programs with conditions and loops.
- To use functions for structuring Python programs.
- To represent compound data using Python lists, tuples, dictionaries.
- To use OOPS concepts in Python.
- To read and write data from/to files in Python

## LIST OF EXPERIMENTS

1. Basic Python Programs.
2. Write programs to demonstrate different number data types in python.
3. Develop python programs to demonstrate various conditional statements.
4. Implement user defined functions using python.
5. Develop python scripts to demonstrate functions.
6. Develop python programs to perform various string operations like slicing, indexing & formatting.
7. Develop python programs to perform operations on List & Tuple.
8. Demonstrate the concept of Dictionary with python programs.
9. Develop python codes to demonstrate concept of class and objects.
10. Demonstrate OOPS concepts like inheritance and polymorphism with python programs.
11. Demonstrate python codes to print try, except and finally block statements.
12. Implement python programs to perform file operations.
13. Implement python programs using modules and packages.
14. Simulate bouncing ball using Pygame.

**Mini Project :Suggested Topics(but not limited to)**

1. Dice roll simulator.
2. Guess the number game.
3. Sending emails using python.
4. Random password generator.
5. Alarm clock.
6. URL shortener.

**TOTAL: 60 PERIODS**

**OUTCOMES:**

1. To write, test, and debug simple Python programs.
2. To implement Python programs with conditions and loops.
3. To use functions for structuring Python programs.
4. To represent compound data using Python lists, tuples, dictionaries.
5. To use OOPS concepts in Python.
6. To read and write data from/to files in Python

**WEB REFERENCES:**

1. https://www.programiz.com/python-programming/examples
2. https://www.geeksforgeeks.org/python-programming-examples/
3. https://beginnersbook.com/2018/02/python-programs/
4. https://www.javatpoint.com/python-programs
5. https://www.w3schools.com/python/python_examples.asp
6. https://www.sanfoundry.com/python-problems-solutions/

| 21BS1111 | PHYSICS AND CHEMISTRY LABORATORY | L | P | T | C |
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**OBJECTIVES:**

- To introduce different experiments to test basic understanding of physics concepts applied in optics, thermal physics, properties of matter and liquids.

**LIST OF EXPERIMENTS (Minimum of experiments to be conducted: 5 Experiments)**

1. Determination of rigidity modulus – Torsion pendulum
2. Determination of Young's modulus by non-uniform bending method
3. (a) Determination of wavelength, and particle size using Laser
   (b) Determination of acceptance angle in an optical fiber
4. Determination of thermal conductivity of a bad conductor – Lee's Disc method
5. Determination of velocity of sound and compressibility of liquid – Ultrasonic interferometer
6. Determination of wavelength of mercury spectrum – spectrometer grating
7. Determination of band gap of a semiconductor
8. Determination of thickness of a thin wire – Air wedge method

**TOTAL: 30 PERIODS**

**OUTCOME:**

- Upon completion of the course, the students will be able to apply principles of elasticity, optics and thermal properties for engineering applications.

**TEXT BOOKS**


1. Ruby Das, C.S. Robinson, Rajesh Kumar, Prashant Kumar Sahu, A Textbook of Engineering Physics Practical, University Science Press, Delhi, II Edition (2016), ISBN 978-93-80386-86-7
2. Harnam Singh, Dr.P.S. Hemne, B.Sc., Practical Physics, S.Chand & Company Ltd, New Delhi, Edition 2011, ISBN 81-219-0469-2


**WEB REFERENCES:**

1. https://www.vlab.co.in/broad-area-physical-sciences
2. https://vlab.amrita.edu/?sub=1

## CHEMISTRY LABORATORY

**OBJECTIVES:**

- To inculcate experimental skills to test basic understanding of water quality parameters such as, alkalinity, hardness, DO and chloride.
- To induce the students to familiarize with electroanalytical techniques such as, pH metry,potentiometry and conductometry in the determination of aqueous solutions.

**LIST OF EXPERIMENTS (Minimum of experiments to be conducted: 5 Experiments)**

1. Estimation of HCl using $Na_2CO_3$ as primary standard and Determination of Alkalinity in Water sample.
2. Determination of total, temporary & permanent hardness of water by EDTA method.
3. Determination of DO content of water sample by Winkler‟s method.
4. Determination of chloride content of water sample by argentometric method.
5. Estimation of copper content of the given solution by Iodometry.
6. Determination of strength of given hydrochloric acid using pH meter.
7. Determination of strength of acids in a mixture of acids using conductivity meter.
8. Estimation of iron content of the given solution using potentiometer.
9. Determination of total, temporary & permanent hardness of water by EDTA method.
10. Estimation of iron content of the water sample using spectrophotometer (1, 10-26, Phenanthroline / thiocyanate method).
11. Estimation of sodium and potassium present in water using flame photometer.
12. Determination of molecular weight of polyvinyl alcohol using Ostwald viscometer.
13. Pseudo first order kinetics-ester hydrolysis.
14. Corrosion experiment-weight loss method.
15. Phase change in a solid.

**TOTAL: 30 PERIODS**

**OUTCOME:**

- To analyse the quality of water samples with respect to their acidity, alkalinity, hardness and DO
- To quantitatively analyse the aqueous solution by electroanalytical techniques

**TEXT BOOKS**


1. Laboratory Manual- Department of Chemistry, CEGC, Anna University (2014).
2. Vogel’s Textbook of Quantitative Chemical Analysis (8th edition, 2014).

| 21HS1201 | COMMUNICATIVE ENGLISH & LANGUAGE SKILLS LAB II INTEGRATED | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 2 | 4 |

**OBJECTIVES:**

- To develop linguistic and strategic competence in workplace context and to enhance language proficiency and thereby the employability of budding engineers and technologists.
- To improve the relevant language skills necessary for professional communication.
- To help learners to develop their listening skills, which will, enable them to listen to lectures and comprehend them by asking questions; seeking clarification and developing their speaking skills and to speak fluently in real contexts.
- To Introduce them to life skills, their importance in leading Personal & professional life,key concepts of business communication and Communicative skills.

**UNIT - I INTERPERSONAL COMMUNICATION 9**

**Listening:** Listening to Telephone Conversations. **Speaking**: Role Play Exercises Based on Workplace Contexts, Introducing Oneself - PEP Talks. **Reading:** Reading the Interview of an Achiever and Completing Exercises (Skimming, Scanning and Predicting). **Writing:** Writing a Short Biography of an Achiever Based on Given Hints, **Grammar:** Adjective, Sentence pattern. **Vocabulary** Development: Idioms and Phrases.

**UNIT - II TECHNICAL COMMUNICATION 9**

**Listening:** Listening to Talks/Lectures Both General and Technical and Summarizing the Main Points. **Speaking:** Participating in Debates ,TED Talks **Reading:** Reading Technical Essays/ Articles and Answering Comprehension Questions **Writing:** Summary Writing, Minutes of the meeting **Grammar:** Participle Forms, Relative Clauses **Vocabulary Development:** Compound Words, Abbreviations and Acronyms.

**UNIT - III PROCESS DESCRIPTION 9**

**Listening:** Listening to a Process Description and Drawing a Flowchart **Speaking:** Participating in Group Discussions, Giving Instructions, Presentation **Reading:** Reading Instruction Manuals **Writing:** Process Descriptions – Writing Instructions **Grammar:** Use of Imperatives, Active and Passive Voice, Sequence Words **Vocabulary Development:**Misspelt words. Homophones andHomonyms.

**UNIT - IV REPORT WRITING 9**

**Listening:** Listening to a Presentation and Completing Gap-Filling Exercises **Speaking:** Making Formal Presentations **Reading:** Reading and Interpreting Charts/Tables and diagrams **Writing:** Interpreting Charts/Tables and Diagrams, Writing a Report **Grammar:** Direct into Indirect Speech, Use of Phrases **Vocabulary Development:** Reporting Words, Technical Jargon.

**UNIT - V APPLYING FOR JOBS 9**

**Listening:** Listening to a Job Interview and Completing Gap-Filling Exercises **Speaking:** Mock Interview, Telephone Interviews, GD **Reading:** Reading a Job Interview, SOP, Company Profile and Completing Comprehension Exercises **Writing:** Job Applications and Resumes **Grammar:** Conditional Clauses, Modal verbs **Vocabulary Development:** Technical Vocabulary, Purpose Statement.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

- Read and comprehend technical texts effortlessly.
- Write thoughts and insights of their own.
- Recognize the need for life skills, apply them to different situations, the basic communicationpractices in different types of communication.
- Gain confidence to communicate effectively in various situations to acquire employabilityskills.
- Become an active listener of professional contexts.

**TEXT BOOKS:**

1. Richards, C. Jack. *Interchange,* New Delhi: CUP, 2017
2. Board of Editors. *English for Engineers and Technologists* Volume 2 Orient Black Swan
   Limited, 2020.

**REFERENCES:**

1. Kumar, Suresh. E. Engineering English. Orient Blackswan: Hyderabad,2015
2. Raman, Meenakshi and Sharma, Sangeetha- Technical Communication Principles and Practice.Oxford University Press: New Delhi, 2014.
3. Grussendorf, Marion, English for Presentations, Oxford University Press, Oxford: 2007.
4. Means, L. Thomas and Elaine Langlois, English & Communication For Colleges. CengageLearning, USA: 2007.
5. Students can be asked to read Tagore, Chetan Bhagat and for supplementary reading.

**WEB REFERENCES:**

1. https://learnenglishteens.britishcouncil.org/exams/grammar-and-vocabulary-exams/word- formation
2. https://cdn.s3waas.gov.in/s347d1e990583c9c67424d369f3414728e/uploads/2018/02/20 1803
   1621.pdf
3. http://xn--englishclub-ql3f.com/grammar/parts-of-speech.htm
4. https://www.edudose.com/english/grammar-degree-of-comparison-rules/

**ONLINE COURSES / RESOURCES:**

1. https://basicenglishspeaking.com/wh-questions/
2. https://agendaweb.org/verbs/modals-exercises.html
3. https://cdn.s3waas.gov.in/s347d1e990583c9c67424d369f3414728e/uploads/2018/02/20 1803 1621.pdf
4. https://www.ego4u.com/en/cram-up/grammar/prepositions

**List of exercises Minimum of exercises to be conducted: 15**

1. Listen to lectures - articulate a complete idea as opposed to producing fragmented utterances –Tedtalks, Science Fiction – My fair lady
2. Listening to a process information – General Competitive Examinations, GRE
3. Listening for specific information: accuracy and fluency – BEC
4. Listening - following, responding to explanations, giving directions and instructions inacademic andbusiness contexts – IELTS, TOEFL.
5. Listening to transcripts and answer to the questions.
6. Listening: Read aloud in class and gap - filling.
7. Listening: Recognizing and interpreting non - verbal cues.
8. Listen first, speak second - Having the mindset of a listener.
9. Speaking – sharing personal information - Self introduction
10. Speaking – Small talk or Pep Talk

.

11. Speaking – Group discussion, Visume –visual presentation of resume
12. Speaking – Presentation – Formal and Informal
13. Speaking – Mock interview
14. Speaking – FAQ‟S on Job interview
15. Speaking : Simulations - (show and tell)
16. Speaking: News brief - Ripped from today's headlines.
17. Speaking: Who's telling the truth?
18. Speaking: JAM
19. Speaking: Debate
20. Speaking: Story Narration

**TOTAL: 30 PERIODS**

**SOFTWARE REQUIRED:**

1. Globarena.

**TEXT BOOKS:**


1. Brooks, Margret. Skills for Success. Listening and Speaking. Level 4 Oxford UniversityPress, Oxford:2011.
2. Richards, C. Jack. & David Bholke. Speak Now Level 3. Oxford University Press, Oxford:2010


**REFERENCES:**


1. Bhatnagar, Nitin and Mamta Bhatnagar. Communicative English for Engineers and Professionals. Pearson: New Delhi, 2010.
2. Ladousse, Gillian Porter. Role Play. Oxford University Press: Oxford, 2014.
3. Richards C. Jack. Person to Person (Starter). Oxford University Press: Oxford, 2006.
4. Vargo, Mari. Speak Now Level 4. Oxford University Press: Oxford, 2013.
5. E. Suresh Kumar et al. Communication for Professional Success, Orient Blackswan: Hyderabad, 2015.
6. Raman, Meenakshi and Sangeeta Sharma. Professional Communication. Oxford University
   Press: Oxford, 2014.

| 21MA1201 | ENGINEERING MATHEMATICS II | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 1 | 0 | 4 |

**OBJECTIVES:**

- Vectors are very helpful for the engineering students as it will give the insight Into how totrace along the different types of curves.
- To develop an understanding of the standard technique of a complex variable theory in Particular of analytics functions and its mapping property.
- Complex integration is an intuitive extension of real integration. Complex variable techniques have been used in a wide variety of areas of engineering. This has been particularly true inareas such as electromagnetic field theory, fluid dynamics, aerodynamics and elasticity.
- To solve the linear differential equations with constant coefficients.
- Laplace Transform is very useful for the electronics students , this gives the basics of how to solve the problems in electronic circuits.

**UNIT - I** **VECTOR CALCULUS** **12**

Gradient, divergence and curl – Directional derivative – Irrotational and solenoidal vector fields – Vector integration – Green's theorem in a plane - Gauss divergence theorem and Stokes" theorem (excluding proofs) – Simple applications involving cubes, rectangular parallelepiped, sphere and cylinder.

**UNIT - II** **ANALYTIC FUNCTIONS** **12**

Functions of a complex variable – Analytic functions - Cauchy-Riemann equations - Necessary and sufficient conditions– Harmonic and orthogonal properties of analytic function –Harmonic conjugate.– Construction of analytic functions by Milne Thomson method– Conformal mapping: $w = z+c$, $cz$, $1/z$, $z^2$ and bilinear transformation.

**UNIT - III** **COMPLEX INTEGRATIONS** **12**

Line integrals- Cauchy's integral theorem-Cauchy's integral formula - Singularities – Residues– Cauchy's residue theorem - Taylor's and Laurent's series expansions —– Application of residue theorem for evaluation of real definite integrals – Use of circular contour and semi- circular contour (excluding poleson the real axis).

**UNIT - IV** **ORDINARY DIFFERENTIAL EQUATIONS** **12**

Higher order linear differential equations with constant coefficients -Method of variation of parameters – Homogenous equation of Euler's and Legendre's type – System of simultaneous linear differential equations with constant coefficients - Method of undetermined coefficients.

**UNIT - V** **LAPLACE TRANSFORMS** **12**

Laplace transform – Sufficient condition for existence – Transform of elementary functions – Basic properties – Transforms of derivatives and integrals of functions - Derivatives and integrals of transforms -Transforms of unit function, unit step function and unit impulse functions – Transform ofperiodic functions– Initial and final value theorems. Inverse Laplace transform -Convolution theorem–Solution of linear ODE of second order with constant coefficients using Laplace transformation techniques.

**TOTAL: 60 PERIODS**

**OUTCOMES:**

1. Can identify the Gradient, divergence and curl of a vector point function and related identities.Evaluation of line, surface and volume integrals using Gauss, Stokes and Green's theorems and
   their verification.
2. Understanding analytic functions, harmonic functions, conformal mapping.
3. Determine the types of singularities, residues, contour integration.
4. Apply various techniques in solving differential equations.
5. Able to solve differential equations using Laplace transforms.
6. Can identify the Gradient, divergence and curl of a vector point function and related identities. Evaluation of line, surface and volume integrals using Gauss, Stokes and Green's theorems and their verification.
7. Understanding analytic functions, harmonic functions, conformal mapping.

**TEXT BOOKS:**


1. Grewel. B.S, "Higher Engineering Mathematics", 43rd Edition, Khanna Publications, Delhi,2014.
2. B.V. Ramana, " Higher Engineering Mathematics", McGraw Hill Education, India.
3. Bali N., Goyal M. and Walkins C., "Advanced Engineering Mathematics", Firewall Media(An imprint of Lakshmi Publications Pvtt. Ltd.,), New Delhi, 7th Edition, 2009.


**REFERENCE BOOKS:**


1. Kreyszig Erwin, Advanced Engineering Mathematics", John wiley and Sons, 10th Edition,New Delhi.
2. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications,
   New Delhi, 3rd Edition, 2007.
3. O"Neil, P.V. "Advanced Engineering Mathematics", Cengage Learning India Pvt. Ltd, NewDelhi, 2007.
4. Sastry, S.S, "Engineering Mathematics", Vol.I & II, PHI Learnig Pvt. Ltd, 4th Edition, NewDelhi, 2014.
5. Wyile, R.C. and Barrett, L.C., "Advanced Engineering Mathematics "Tata McGraw Hill Education Pvt Ltd, 6th Edition, New Delhi, 2012.


**ONLINE COURSES / RESOURCES:**

1. https://onlinecourses.nptel.ac.in/noc21_ma69
2. https://onlinecourses.nptel.ac.in/noc21_ma57

| 21PH1202 | PHYSICS FOR CIVIL ENGINEERING | L | T | P | C |
|---|---|---|---|---|---|
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**OBJECTIVE:**

- To introduce the principles of thermal, acoustics, optics and new materials for civil engineering applications.

**UNIT - I THERMAL PERFORMANCE OF BUILDINGS 9**

Heat transfer through fenestrations, thermal insulation and its benefits - factors affecting the thermal performance of buildings, thermal measurements, thermal comfort, indices of thermal comfort, climate and design of solar radiation, shading devices. Principles of natural ventilation - ventilation measurements, design for natural ventilation.

**UNIT - II ACOUSTICS 9**

Classification of sound- decibel- Weber–Fechner law – Sabine's formula- derivation using growth and decay method – Absorption Coefficient and its determination –factors affecting acoustics of buildings and their remedies. Methods of sound absorptions - absorbing materials - sound insulation and its measurements, impact of noise in multi-storeyed buildings.

**UNIT - III LIGHTING DESIGNS 9**

Radiation quantities – spectral quantities – relationship between luminescence and radiantquantities – hemispherical reflectance and transmittance – photometry: cosines law, inversesquare law. Colour – luminous efficiency function - Visual field glare, colour - day light calculations - day light design of windows, measurement of day-light and use of models and artificial skies, principles of artificial lighting, supplementary artificial lighting.

**UNIT - IV NEW ENGINEERING MATERIALS 9**

Composites - definition and classification - Fibre reinforced plastics (FRP) and fiber reinforced metals (FRM) - Shape memory alloys - Ceramics - Classification - Crystalline - Non Crystalline - Bonded ceramics, Manufacturing methods - Slip casting - Isostatic pressing - Gas pressure bonding - Properties - thermal, mechanical, electrical and chemical ceramic fibres - High Aluminium ceramics.

**UNIT - V HAZARDS 9**

Earth quake ground motion - Basic concepts and estimation techniques - Probabilistic and deterministic Seismic hazard analysis - Fire hazards and fire protection, fire-proofing of materials, fire safety regulations and firefighting equipment - Prevention and safety measures.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

1. Upon completion of this course, the students will have knowledge on the thermal performance of buildings.
2. Upon completion of this course, the students will acquire knowledge on the acoustic properties of buildings.
3. Upon completion of this course, the students will get knowledge on various lighting designs for buildings.
4. Upon completion of this course, the students will gain knowledge on the properties and performance of engineering materials.
5. Upon completion of this course, the students will understand the hazards of buildings.

**TEXT BOOKS:**


1. Alexander, D. “Natural disaster”, Springer (1993).
2. Budinski, K.G. &Budinski, M.K. “Engineering Materials Properties and Selection”, Prentice Hall, 2009.
3. Severns, W.H. & Fellows, J.R. “Air conditioning and Refrigeration”, John Wiley and Sons, London, 1988.
4. Stevens, W.R., “Building Physics: Lighting: Seeing in the Artificial Environment, Pergaman Press, 2013.


**REFERENCES:**


1. Gaur R.K. and Gupta S.L., Engineering Physics. DhanpatRai publishers, 2012.
2. Reiter, L. “Earthquake hazard analysis - Issues and insights”, Columbia University Press, 1991.
3. Shearer, P.M. “Introduction to Seismology”, Cambridge University Press, 1999.


**WEB REFERENCES:**

1. https://www.researchgate.net/publication/319432165_Building_physics_Performance_of_buildings.
2. https://courses.physics.illinois.edu/phys406/sp2017/Lecture_Notes/P406POM_Lecture.
3. https://nptel.ac.in/content/storage2/courses/105108124/pdf/Lecture_Notes/LNm1.pdf
4. https://ncert.nic.in/ncerts/l/kegy107.pdf

**ONLINE COURSES / RESOURCES:**

1. https://nptel.ac.in/courses/124/105/124105004/
2. https://nptel.ac.in/courses/105/104/105104183/

| 21ES1203 | BASIC ELECTRICAL AND ELECTRONICS ENGINEERING | L | T | P | C |
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**OBJECTIVES:**

- To understand the basic concepts of electric circuits.
- To study about the three phase system and magnetic circuits.
- To understand the operation of AC machines.
- To understand the basic concepts of domestic wiring and instruments.
- To understand the working principle of electronic devices.

**UNIT - I BASIC CIRCUITS 9**

Current- Voltage- Power- Voltage Source – Current Source- Ohm's Law – KCL – KVL (Analysis with only independent source) – Resistors in series and parallel – Current Division – Voltage Division-Phasors- RMS value of current and voltage – Active power- Apparent Power- Complex Power – Power Factor.

**UNIT - II THREE PHASE CIRCUITS & MAGNETIC CIRCUITS 9**

Three Phase Supply – Advantages of three phase system- Star Connection – Delta Connection – Power in three phase system- Measurement of Three phase power. Magnetic circuits- MMF, Flux, Reluctance, Magnetic field intensity, Flux density, Self and Mutual inductances-Simple problems

.

**UNIT - III ELECTRICAL MACHINES 9**

Construction of DC Machine- Working Principle of DC machine- EMF equation – Torque Equation-Types of Motor- Shunt – Series – Compound – Application – Single phase induction motor - Stepper Motor.

**UNIT - IV DOMESTIC WIRING AND INTRUMENTS 9**

Types of wiring- Domestic wiring - Specification of Wires – Energy Auditing -Earthing methods-Protective devices, Classification of instruments – Operating Principles of indicating Instruments – Moving iron, Moving coil and wattmeter.

**UNIT - V BASICS OF ELECTRONICS 9**

P-N junction, V-I Characteristics of PN junction diode and Zener diode, Half Wave Rectifier-Full Wave Rectifier – Principle and Characteristics of BJT, SCR, JFET, MOSFET.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

1. To be able to understand the concepts related with electrical circuits.
2. To be able to study the different three phase connections and the concepts of magnetic circuits
3. Capable of understanding the operating principle of AC machines
4. Capable of understanding the concepts of domestic wiring and instruments
5. To be able to understand the working principle of electronic devices such as diode and zener diode and BJT.

**TEXT BOOKS:**


1. Kothari DP and I.J Nagrath, "Basic Electrical and Electronics Engineering", McGraw Hill Education, 2014.
2. Del Toro, "Electrical Engineering Fundamentals", Second edition, Pearson Education, Delhi, 1989.

3. V N Mittle and AravindMital, “Basic Electrical Engineering”, Second edition, Tata McGraw Hill Publication, 2006.

**REFERENCES:**

1. C L Wadhwa, “Basic Electrical Engineering”, Fourth edition, New Age International Publication, 2007.
2. V K Metha, RohithMetha, Basic Electrical Engineering”, Sixth edition, S Chand &Company Ltd, 2012.
3. R K Rajput, “Basic Electrical and Electronics Engineering”, Second edition, University Science Press, 2012.

**WEB REFERENCES:**

1. https://nptel.ac.in/courses/108/105/108105053/
2. https://www.electrical4u.com/electrical-engineering-articles/basic-electrical/
3. https://library.automationdirect.com/basic-electrical-theory/
4. https://electrical-engineering-portal.com/download-center/books-and-guides/electrical-engineering

**ONLINE COURSES / RESOURCES:**

1. https://learnengineering.org - Resources
2. https://www.youtube.com/channel/UCqZQJ4600a9wIfMPbYc60OQ - Resources
3. https://en.wikipedia.org/wiki/Electrical_engineering - Resources
4. https://www.edx.org/learn/electrical-engineering - Online courses
5. https://www.khanacademy.org/science/electrical-engineering/introduction-to-ee- Online courses

| 21ME1201 | ENGINEERING MECHANICS | L | T | P | C |
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**OBJECTIVES:**

- To understand the concepts of resultant force and moment of a particle and rigid body.
- To understand the concepts of equilibrium of particles and rigid bodies in 2D and 3D.
- To understand the concepts of centroid, moment of inertia and mass moment of inertia.
- To understand the concepts of kinematics of particles and rigid bodies.
- To understand the concepts of kinetics of particles and rigid bodies.
- To understand the concepts of frictional force**.**

**UNIT - I STATICS OF PARTICLES 9+3**

Introduction - Units and dimensions – Fundamental laws of Mechanics - Principle of transmissibility - Parallelogram and triangular Law of forces - Vectorial representation of forces - Vector operations of forces - 2D Force system - Rectangular components of force - Equilibrium of a particle in 2D - Lami's theorem - 3D Force system - Equilibrium of a particle in 3D.

**UNIT - II STATICS OF RIGID BODIES 9+3**

Moments and Couples – Moment of a force about a point and about an axis – Vectorial representation of moments and couples – Scalar components of a moment – Varignon's theorem – Single equivalent force - Free body diagram – Types of supports and their reactions - Equilibrium of Rigid bodies in 2D – Equilibrium of Rigid bodies in 3D – Case studies.

**UNIT - III PROPERTIES OF SURFACES AND SOLIDS 9+3**

Centroid of areas – simple and composite areas - Theorems of Pappus and Guldinus – Centre of mass – simple and composite volumes - Moment of inertia - simple and composite areas - Parallel axis theorem and perpendicular axis theorem - Polar moment of inertia - Radius of gyration – Product of inertia - Principal moment of inertia of plane areas - Mass moment of inertia of simple solids.

**UNIT - IV FRICTION AND DYNAMICS OF RIGIDBODIES 9+3**

Friction -Laws of dry friction - Angle of friction - Coefficient of static and kinetic friction – Slidingfriction - Rolling resistance.Kinematics - Translation and Rotation of Rigid Bodies – Velocity and acceleration –General Plane motion of simple rigid bodies such as cylinder and sphere.Kinetics – Work done on a rigid body - Kinetic energy of a rigid Body – Conservation of energy and momentum principle for a rigid body.

**UNIT - V DYNAMICS OF PARTICLES 9+3**

Kinematics - Rectilinear Motion and Curvilinear Motion of Particles - Equations of Motions - Projectile Motion.Kinetics - Newton's Second Law of Motion – D'Alembert's Principle – Work and Energy Principle - Impulse and Momentum Principle – Principle of Virtual work - Impact of elastic bodies

**TOTAL: 60 PERIODS**

**OUTCOMES:**

1. Upon completion of the course, students will be able to
2. Evaluate the resultant force and moment of 2D and 3D force systems.
3. Apply the concepts of equilibrium of particles and rigid bodies in engineering problems.
4. Evaluate the centroid, moment of inertia and mass moment of inertia of composite areas and volumes.
5. Apply the equations of linear and projectile motions to solve physical problems.
6. Apply the concepts of equilibrium of rigid bodies in engineering problems.
7. Apply the concepts of frictional force in practical applications**.**

**TEXT BOOKS:**


1. Beer F.P and Johnston Jr. E.R, "Vector Mechanics for Engineers (In SI Units): Statics and Dynamics", 8thEdition, Tata McGraw-Hill Publishing Company, New Delhi, 2004.
2. Rajasekaran S and Sankarasubramanian G, "Engineering Mechanics Statics and Dynamics", 3rd Edition, Vikas Publishing House Pvt. Ltd., 2005.
3. Balasubramaniam T.V and Murugan R, “Engineering Mechanics”, 1st Edition, Vijay Nicole Imprints, 2015.


**REFERENCES:**


1. Irving H. Shames and Krishna MohanaRao G., "Engineering Mechanics - Statics and Dynamics", 4thEdition, Pearson Education, 2006.
2. Hibbeller R.C and Ashok Gupta, "Engineering Mechanics: Statics and Dynamics", 11thEdition, Pearson Education, 2010.
3. Meriam J.L and Kraige L.G, "Engineering Mechanics - Statics - Volume 1, Dynamics Volume 2", 3rdEdition, John Wiley & Sons,1993.
4. Bhavikatti S.S and Rajashekarappa, K.G, "Engineering Mechanics", New Age International (P) Limited Publishers, 2005.
5. Vela Murali, "Engineering Mechanics", Oxford University Press, 2010.


**WEB REFERENCES:**

1. http://www.iitg.ac.in/rkbc/me101/me101.htm
2. https://ocw.mit.edu/courses/civil-and-environmental-engineering/1-050-engineering-mechanics-i-fall-2007/index.htm
3. http://hyperphysics.phy-astr.gsu.edu/hbase/hframe.html

**ONLINE COURSES / RESOURCES:**

1. https://nptel.ac.in/courses/112/106/112106286/
2. https://nptel.ac.in/courses/122/104/122104015/
3. https://www.coursera.org/learn/engineering-mechanics-statics
4. https://www.edx.org/course/engineering-mechanics-2

| 21CE1211 | COMPUTER AIDED BUILDING DRAWING | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 4 | 2 |

**OBJECTIVES:**

1. To introduce the students to draft the plan, elevation and sectional views of buildings in accordance with development and control rules satisfying orientation and functional requirements as per National Building Code.

**List of Experiments:**

1. Principles of planning, orientation and complete joinery details (PaneledandGlazed Doorsand Windows)
2. Buildings with load bearing walls
3. Buildings with sloping roof
4. R.C.C. framed structures
5. Industrial buildings –North light roof structures

**TOTAL: 60 PERIODS**

**OUTCOMES:**

1. The students will be able to draft the plan, elevation and sectional views of the buildings, industrial structures, and framed buildings using computer softwares.

**TEXT BOOKS:**


**1.** SikkaV.B.,ACourseinCivilEngineeringDrawing,4thEdition, S.K.KatariaandSons, 2015.

**2.** George Omura, Mastering inAutocad 2005 and Autocad LT, 2005–BPB Publications, 2008


**REFERENCES:**


**1.** Chuck Eastman, Paul Teicholz, Rafael Sacks, Kathleen Liston, BIM Handbook:AGuidetobuilding information modeling for Owners, Managers, Designers, Engineers, and Contractors, John Wiley and Sons. Inc.,2011.

**2.** MarimuthuV.M.,MurugesanR.andPadminiS.,CivilEngineeringDrawing-I, Pratheeba Publishers, 2008.

**3.** Shah.M.G.,Kale. C.M.andPatki.S.Y.,Building Drawing with an Integrated Approach to Built Environment, Tata McGraw Hill Publishers Limited, 2007.

**4.** Verma B. P., Civil Engineering Drawing and House Planning, Khanna Publishers, 2010

| 21ES1211 | ENGINEERING PRACTICES LABORATORY | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 4 | 2 |

**OBJECTIVE:**

- To provide exposure to the students with hands on experience on various basic engineering practices in Civil, Mechanical, Electrical and Electronics Engineering.

**GROUP A CIVIL & ELECTRICAL**

**I CIVIL ENGINEERING PRACTICES** **15**

**Plumbing Work**:

a) Connecting various basic pipe fittings like valves, taps, coupling, unions, reducers, elbows and
b) Other components which are commonly used in household.
c) Preparing plumbing line sketches.
d) Laying pipe connection to the suction side of a pump
e) Laying pipe connection to the delivery side of a pump.
f) Connecting pipes of different materials: Metal, plastic and flexible pipes used in household appliances.

**Wood Work**:

a) Introduction to Tools and Equipments
b) Simple Planning and sawing practice
c) Making Half Lap, Dovetail, Mortise and Tenon joints

**Wood Work Study**:

a) Studying joints in door panels and wooden furniture
b) Studying common industrial trusses using models.

**15**

**IIELECTRICAL ENGINEERING PRACTICES**:

a) Residential house wiring using switches, fuse, indicator, lamp and energy meter.
b) Fluorescent lamp wiring.
c) Stair case wiring
d) Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit.
e) Measurement of energy using single phase energy meter.
f) Measurement of resistance to earth of an electrical equipment.

**GROUP B MECHANICAL AND ELECTRONICS**

**III MECHANICAL ENGINEERING PRACTICES** **15**

**Basic Machining Work**:

a) Introduction to Lathe machine, Tools and Equipments
b) Simple Turning and facing
c) Step turning
d) Simple Drilling and Tapping of flat plate

**Welding Work**:

a) Introduction to Arc welding, Tools and Equipments
b) Welding of Butt Joints, Lap Joints, and Tee Joints using arc welding.

**Assembly Work**:

a) Assembling a centrifugal pump.
b) Assembling an air conditioner.

**Sheet Metal Work**:

a) Demonstrating basic sheet metal operations

**Foundry Work**:

a) Demonstrating basic foundry operations.

**IV ELECTRONICS ENGINEERING PRACTICES 15**

a) Study of Electronic components and equipments–Resistor, colour coding
b) Measurement of AC signal parameter(peak-peak,rmsperiod,frequency)usingCRO.
c) Study of logic gates AND, OR,EX-OR and NOT.
d) Generation of Clock Signal.
e) Solderingpractice–ComponentsDevicesandCircuits– UsinggeneralpurposePCB.
f) Measurement of ripple factor of HWR and FWR.

**TOTAL: 60 PERIODS**

**OUTCOMES:**

1. Connecting various basic pipe fittings and other components which are commonly used in household and to know about the various tools, Equipments and making different joints
2. To know the Lathe machine, Tools and Equipments with machining experiments and have knowledge about Arc welding, Tools and Equipments with making different joints
3. To carry out basic home electrical works and appliances and measure the electrical quantities
4. To analyze the basic electronic circuits and to solder simple components on PCB and test simple electronic circuits

**TEXT BOOKS:**

1. Jeyapoovan T., Saravanapandian M. & Pranitha S., “Engineering Practices Lab Manual”, Vikas Publishing House Pvt.Ltd, (2006)
2. Kannaiah P. & Narayana K.L., “Manual on Workshop Practice”, Scitech Publications, (1999).
3. Jeyachandran K., Natarajan S. &Balasubramanian S., “A Primer on Engineering Practices Laboratory”, Anuradha Publications, (2007).
4. S. Gowri& T. Jeyapoovan, “Enginering Practices Lab Manual 5/E”, S. Chand Publishing, 2019

**REFERENCES:**

1. K.C. John, "Mechanical workshop practice", Second edition, PHI learning Pvt Ltd, New Delhi
2. Bawa H.S., “Workshop Practice”, Tata McGraw – Hill Publishing Company Limited, (2007)

**WEB REFERENCES**

1. https://nptel.ac.in/courses/112/107/112107090/
2. https://nptel.ac.in/courses/112/107/112107084/

| 21MA1303 | TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 1 | 0 | 4 |

**OBJECTIVES:**

- To introduce the basic concepts of PDE for solving standard Partial differential equations.
- To introduce Fourier series analysis which is core to many applications in engineering field apart from its use in solving boundary value problems?
- To acquaint the student with Fourier series techniques in solving heat flow problems used in various situations.
- To acquaint the student with Fourier transform techniques used in various situations.
- To introduce the effective Mathematical tools in solutions of partial differential equations, that helps besides several physical processes and to develop Z transform techniques in discrete time systems.

**UNIT 1 PARTIAL DIFFERENTIAL EQUATIONS 12**

Formation of partial differential equations - Solutions to standard types of first order partial differential equations - Lagrange's linear equation - Second and higher order with constant coefficients of homogeneous linear partial differential equations.

**UNIT II FOURIER SERIES 12**

Dirichlet's conditions – General Fourier series - Odd and even functions - Change of interval- Half range sine series – Half range cosine series – RMS values- Parseval's identity – Harmonic analysis.

**UNIT III APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS 12**

Classification of PDE - Fourier Series Solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two dimensional equation of heat conduction in Cartesian coordinates.

**UNIT IV FOURIER TRANSFORMS 12**

Statement of Fourier integral theorem – Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.

**UNIT V Z - TRANSFORMS AND DIFFERENCE EQUATIONS 12**

Z-transforms - Elementary properties –Initial and final value theorems- Inverse Z-transform (Using partial fraction method and Residue method ) - Convolution theorem– Formation of difference equation-Solution of difference equations using Z - transform.

**TOTAL: 60 PERIODS**

**OUTCOMES:**

**1.** Apply the basic Knowledge to identify and deal with partial differential equations and their solutions.
**2.** Understand the principles of Fourier series in solving engineering problems.
**3.** Solve one dimensional equation using Fourier series techniques.
**4.** Solve two dimensional equations using Fourier series techniques.
**5.** Understand the mathematical principles on Fourier transforms.
**6.** Utilise the basic knowledge in solving difference equations using Z-transforms.

**TEXT BOOKS:**

1. Grewal B.S., “Higher Engineering Mathematics", 43rd Edition, Khanna Publishers, New Delhi, 2014.
2. Narayanan S., Manicavachagom Pillay.T.K and Ramanaiah.G "Advanced Mathematics for Engineering Students", Vol. II & III, S.Viswanathan Publishers Pvt. Ltd, Chennai, 1998.
3.Veerarajan T., "Transforms and Partial Differential Equations", Tata McGraw Hill Education Pvt. Ltd., New Delhi, Second reprint, 2012.
4. Nagarajan G. and Sundar Raj M., "Transforms and Partial Differential Equations", Sree kamalamani Publications , 6th edition , Chennai, 2021.

**REFERENCES:**

1. Andrews, L.C and Shivamoggi, B, "Integral Transforms for Engineers" SPIE Press, 1999.
2. Bali. N.P and Manish Goyal, "A Textbook of Engineering Mathematics", 9th Edition, Laxmi Publications Pvt. Ltd, 2014.
3. Erwin Kreyszig, "Advanced Engineering Mathematics ", 10th Edition, John Wiley, India, 2016.
4. James, G., "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education, 2007.
5. Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2016.
6. Wylie, R.C. and Barrett, L.C., “Advanced Engineering Mathematics “Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi, 2012.

| 21CE1301 | ENGINEERING GEOLOGY | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**OBJECTIVE:**

- At the end of this course the students will be able to understand the importance of geological knowledge such as earth, earthquake, volcanism and to apply this knowledge in projects such as dams, tunnels, bridges, roads, airport and harbor.

**UNIT I PHYSICAL GEOLOGY** **9**

Geology in civil engineering – branches of geology – structure of earth and its composition weathering of rocks – scale of weathering – soils - landforms and processes associated with river, wind, groundwater and sea – relevance to civil engineering. Plate tectonics – Earth quakes – Seismic zones in India.

**UNIT II MINEROLOGY** **9**

Physical properties of minerals – Quartz group, Feldspar group, Pyroxene - hypersthene and augite, Amphibole – hornblende, Mica – muscovite and biotite, Calcite, Gypsum and Clay minerals.

**UNIT III PETROLOGY** **9**

Classification of rocks, distinction between Igneous, Sedimentary and Metamorphic rocks. Engineering properties of rocks. Description, occurrence, engineering properties, distribution and uses of Granite, Dolerite, Basalt, Sandstone, Limestone, Laterite, Shale, Quartzite, Marble, Slate, Gneiss and Schist.

**UNIT IV STRUCTURAL GEOLOGY AND GEOPHYSICAL METHODS** **9**

Geological maps – attitude of beds, study of structures – folds, faults and joints – relevance to civil engineering. Geophysical methods – Seismic and electrical methods for subsurface investigations.

**UNIT V APPLICATION OF GEOLOGICAL INVESTIGATIONS** **9**

Remote sensing for civil engineering applications; Geological conditions necessary for design and construction of Dams, Reservoirs, Tunnels, and Road cuttings - Hydrogeological investigations and mining - Coastal protection structures. Investigation of Landslides, causes and mitigation.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

The students completing this course

- Will be able to understand the importance of geological knowledge such as earth,earthquake, volcanism and the action of various geological agencies.
- Will get basics knowledge on properties of minerals.
- Gain knowledge about types of rocks, their distribution and uses.
- Will understand the methods of study on geological structure.
- Will understand the application of geological investigation in projects such as dams,tunnels, bridges, roads, airport and harbor

**TEXT BOOKS:**


1. Varghese, P.C., Engineering Geology for Civil Engineering Prentice Hall of India LearningPrivate Limited, New Delhi, 2012.
2. Venkat Reddy. D. Engineering Geology, Vikas Publishing House Pvt. Lt, 2010.

3. Gokhale KVGK, "Principles of Engineering Geology", B.S. Publications, Hyderabad 2011.
4. Chenna Kesavulu N. "Textbook of Engineering Geology", Macmillan India Ltd., 2009.
5. Parbin Singh. A "Text book of Engineering and General Geology", Katson publishinghouse, Ludhiana 2009.

**REFERENCES:**

1. Blyth F.G.H. and de Freitas M.H., Geology for Engineers, Edward Arnold, London, 2010.
2. Bell .F.G.. "Fundamentals of Engineering Geology", B.S. Publications. Hyderabad 2011.
3. Dobrin, M.B "An introduction to geophysical prospecting", McGraw Hill, New Delhi, 1988.

| 21CE1302 | STRENGTH OF MATERIALS | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**OBJECTIVES:**

- To learn the fundamental concepts of Stress, Strain and deformation of solids.
- To know the mechanism of load transfer in beams, the induced stress resultants anddeformations.
- To understand the effect of torsion on shafts and springs.
- To analyze plane and space trusses

**UNIT I STRESS, STRAIN AND DEFORMATION OF SOLIDS 9**

Simple Stresses and strains – Elastic constants - Relationship between elastic constants – Stress Strain Diagram – Ultimate Stress – Yield Stress – Deformation of axially loaded member - Composite Bars - Thermal Stresses – State of Stress in two dimensions – Stresses on inclined planes – Principal Stresses and Principal Planes – Maximum shear stress - Mohr's circle method.

**UNIT II TRANSFER OF LOADS AND STRESSES IN BEAMS 9**

Types of loads, supports, beams – concept of shearing force and bending moment - Relationship between intensity of load, Shear Force and Bending moment - Shear Force and Bending Moment Diagrams for Cantilever, simply supported and overhanging beams with concentrated load, uniformly distributed load, uniformly varying load and concentrated moment. Theory of Simple Bending – Stress Distribution due to bending moment and shearing force - Flitched Beams - Leaf Springs.

**UNIT III DEFLECTION OF BEAMS 9**

Elastic curve – Governing differential equation - Double integration method - Macaulay's method - Area moment method - conjugate beam method for computation of slope and deflection of determinant beams.

**UNIT IV TORSION 9**

Theory of Torsion – Stresses and Deformations in Solid and Hollow Circular Shafts – combined bending moment and torsion of shafts - Power transmitted to shaft – Shaft in series and parallel –Closed and Open Coiled helical springs – springs in series and parallel – Design of buffer springs.

**UNIT V ANALYSIS OF TRUSSES 9**

Determinate and indeterminate trusses - Analysis of pin jointed plane determinate trusses by method of joints, method of sections and tension coefficient – Analysis of Space trusses by tension coefficient method.

**TOTAL :45 PERIODS**

**OUTCOMES:**

Students will be able to

- Understand the concepts of stress and strain, principal stresses and principal planes.
- Determine Shear force and bending moment in beams and understand concept of theory ofsimple bending.
- Calculate the deflection of beams by different methods and selection of method fordetermining slope or deflection.
- Apply basic equation of torsion in design of circular shafts and helical springs, .
- Analyze the pin jointed plane and space trusses

**TEXTBOOKS:**


1. Rajput.R.K. “Strength of Materials”, S.Chand and Co, New Delhi, 2015.
2. Punmia.B.C., Ashok Kumar Jain and Arun Kumar Jain, SMTS –I Strength of materials,Laxmi publications. New Delhi, 2015
3. Rattan . S. S, “Strength of Materials”, Tata McGraw Hill Education Private Limited, NewDelhi, 2012
4. Bansal. R.K. “Strength of Materials”, Laxmi Publications Pvt. Ltd., New Delhi, 2010


**REFERENCES :**


1. Timoshenko.S.B. and Gere.J.M, “Mechanics of Materials”, Van Nos Reinbhold, New Delhi1999.
2. Vazirani.V.N and Ratwani.M.M, “Analysis of Structures”, Vol I Khanna Publishers, NewDelhi,1995.
3. Junnarkar.S.B. and Shah.H.J, “Mechanics of Structures”, Vol I, Charotar Publishing House,New Delhi 2016.
4. Singh. D.K., “ Strength of Materials”, Ane Books Pvt. Ltd., New Delhi, 2016
5. Basavarajaiah, B.S. and Mahadevappa, P., Strength of Materials, Universities Press,Hyderabad, 2010.
6. Gambhir. M.L., "Fundamentals of Solid Mechanics", PHI Learning Private Limited., NewDelhi, 2009.

| 21CE1303 | CONSTRUCTION MATERIALS, TECHNIQUES AND PRACTICES | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**OBJECTIVE:**

- To introduce students to various materials commonly used in civil engineering construction and their properties.

**UNIT I STONES – BRICKS – CONCRETE BLOCKS** **9**

Stone as building material – Criteria for selection – Tests on stones – Deterioration and Preservation of stone work – Bricks – Classification – Manufacturing of clay bricks – Tests onbricks – Compressive Strength – Water Absorption – Efflorescence – Bricks for special use –Refractory bricks – Concrete blocks – Lightweight concrete blocks.

**UNIT II LIME – CEMENT – AGGREGATES – MORTAR** **9**

Lime – Preparation of lime mortar – Cement – Ingredients – Manufacturing process – Types and Grades – Properties of cement and Cement mortar – Hydration – Compressive strength – Tensilestrength – Fineness– Soundness and consistency – Setting time – fine aggregates – river sand – crushed stone sand – properties – coarse Aggregates – Crushing strength – Impact strength – Flakiness Index – Elongation Index – Abrasion Resistance – Grading

**UNIT III CONCRETE** **9**

Concrete – Ingredients – Manufacturing Process – Batching plants –mixing – transporting – placing – compaction of concrete –curing and finishing – Ready mix Concrete – Mix specification.

**UNIT IV TIMBER AND OTHER MATERIALS** **9**

Timber – Market forms – Industrial timber– Plywood – Veneer – Thermocol – Panels of laminates
– Steel – Aluminum and Other Metallic Materials – Composition – Aluminium composite panel – Market forms – Mechanical treatment – Paints – Varnishes – Distempers – Bitumens.

**UNIT V MODERN MATERIALS** **9**

Glass – Ceramics – Sealants for joints – Fibre glass reinforced plastic – Clay products – Refractories – Composite materials – Types – Applications of laminar composites – Fibre textiles–Geomembranes and Geotextiles for earth reinforcement.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

On completion of this course the students will be able to

- Compare the properties of most common and advanced building materials.
- understand the typical and potential applications of lime, cement and aggregates
- know the production of concrete and also the method of placing and making of concrete elements.
- understand the applications of timbers and other materials
- Understand the importance of modern material for construction.

**TEXT BOOKS:**


1. Varghese.P.C, "Building Materials", PHI Learning Pvt. Ltd, New Delhi, 2015.
2. Rajput. R.K., "Engineering Materials", S. Chand and Company Ltd., 2008.
3. Gambhir.M.L., "Concrete Technology", 3rd Edition, Tata McGraw Hill Education,

2004
4. Duggal.S.K., "Building Materials", 4th Edition, New Age International, 2008.

**REFERENCES:**

1. Jagadish.K.S, "Alternative Building Materials Technology", New Age International, 2007.
2. Gambhir. M.L., & Neha Jamwal., "Building Materials, products, properties and systems",Tata McGraw Hill Educations Pvt. Ltd, New Delhi, 2012.
3. IS456 - 2000: Indian Standard specification for plain and reinforced concrete, 2011
4. IS4926 - 2003: Indian Standard specification for ready–mixed concrete, 2012
5. IS383 - 1970: Indian Standard specification for coarse and fine aggregate from naturalSources for concrete, 2011
6. IS1542-1992: Indian standard specification for sand for plaster, 2009
7. IS 10262-2009: Indian Standard Concrete Mix Proportioning –Guidelines, 2009

| 21CE1304 | FLUID MECHANICS | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**OBJECTIVE:**

- To understand the basic properties of the fluid, fluid kinematics, fluid dynamics and to analyze and appreciate the complexities involved in solving thefluid flow problems.

**UNIT I FLUID PROPERTIES AND FLUID STATICS** **9**

Fluid – definition, distinction between solid and fluid - Units and dimensions - Properties of fluids - density, specific weight, specific volume, specific gravity, viscosity, compressibility, vapour pressure, capillarity and surface tension - Fluid statics: concept of fluid static pressure, absolute and gauge pressures - pressure measurements by manometers- forces on planes – centre of pressure – buoyancy and floatation.

**UNIT II FLUID KINEMATICS AND DYNAMICS** **9**

Fluid Kinematics – Classification and types of flow - velocity field and acceleration - continuity equation (one and three dimensional differential forms)- stream line-streak line-path line- stream function - velocity potential function - flow net. Fluid dynamics - equations of motion -Euler's equation along a streamline - Bernoulli's equation – applications - venturi meter, orifice meter and Pitot tube- linear momentum equation and its application to pipe bend.

**UNIT III DIMENSIONAL ANALYSIS AND MODEL STUDIES** **9**

Fundamental dimensions - dimensional homogeneity - Rayleigh's method and Buckingham Pi-theorem - dimensionless parameters - similitudes and model studies - distorted models.

**UNIT IV FLOW THROUGH PIPES** **9**

Reynold's experiment - laminar flow through circular pipe (Hagen poiseulle's) - hydraulic and energygradient – flow through pipes - Darcy - Weisbach's equation - pipe roughness -friction factor- Moody's diagram- major and minor losses of flow in pipes - pipes in series and in parallel.

**UNIT V BOUNDARY LAYER** **9**

Boundary layer – definition- boundary layer on a flat plate – laminar and turbulent boundary layer- displacement, energy and momentum thickness – Momentum integral equation- Boundary layer separation and control – drag on flat plate.

**TOTAL: 45 PERIOD**

**OUTCOMES:**

At the end of the course students will be able to

- Get a basic knowledge of fluids in static, kinematic and dynamic equilibrium.
- Understand and solve the problems related to equation of motion.
- Gain knowledge about dimensional and model analysis.
- Learn types of flow and losses of flow in pipes.
- Understand and solve the boundary layer problems.

**TEXT BOOKS*:***


1. Modi P.N and Seth "Hydraulics and Fluid Mechanics including Hydraulic Machines",Standard Book House New Delhi, 2009.
2. Jain.A.K.., "Fluid Mechanics" (Including Hydraulic Machines), Khanna Publishers, TwelfthEdition, 2016.
3. Subramanya.K " Fluid Mechanics and Hydraulic Machines", Tata McGraw Hill EducationPrivate Limited, New Delhi, 2010.
4. Rajput.R.K. "Fluid Mechanics", S.Chand and Co, New Delhi, 2008.

**REFERENCES:**


1. Streeter, V.L., and Wylie, E.B., “Fluid Mechanics”, McGraw Hill, 2000.
2. Fox W.R. and McDonald A.T., Introduction to Fluid Mechanics John-Wiley and Sons,Singapore, 2013.
3. White, F.M., “Fluid Mechanics”, Tata McGraw Hill, 5th Edition, New Delhi, 2017.
4. Mohd. Kaleem Khan, "Fluid Mechanics and Machinery", Oxford University Press, New Delhi,2015.
5. Bansal.R.K., “Fluid Mechanics and Hydraulic Machines”, Laxmi Publications Pvt. Ltd., NewDelhi, 2013.

| 21CE1311 | STRENGTH OF MATERIALS LABORATORY | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 4 | 2 |

**OBJECTIVE:**

To expose the students to the testing of different materials under the action of various forces and determination of their characteristics experimentally.

**LIST OF EXPERIMENTS**

1. Tension test on steel rod
2. Compression test on wood
3. Double shear test on metal
4. Torsion test on mild steel rod
5. Impact test on metal specimen (Izod and Charpy)
6. Hardness test on metals (Rockwell and Brinell Hardness Tests)
7. Deflection test on metal beam
8. Compression test on helical spring
9. Deflection test on carriage spring

**TOTAL: 60 PERIODS**

**OUTCOME:**

- The students will have the required knowledge in the area of testing of materials and components of structural elements experimentally.

**REFERENCES:**


1. Strength of Materials Laboratory Manual, Anna University, Chennai - 600 025.
2. IS1786-2008 (Fourth Revision, Reaffirmed 2013), 'High strength deformed bars and wires for concrete reinforcement – Specification', 2008.


**LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS**

| Sl. No. | Description of Equipment | Quantity |
|---|---|---|
| 1. | UTM of minimum 400 kN capacity | 1 |
| 2. | Torsion testing machine | 1 |
| 3. | Izod impact testing machine | 1 |
| 4. | Hardness testing machine<br>Rockwell<br>Vicker's (any 2)<br>Brinnel | 1 each |
| 5. | Beam deflection test apparatus | 1 |
| 6. | Extensometer | 1 |
| 7. | Compressometer | 1 |
| 8. | Dial gauges | Few |
| 9. | Le Chatelier's apparatus | 2 |
| 10. | Vicat's apparatus | 2 |
| 11. | Mortar cube moulds | 10 |

| 21CE1312 | CONSTRUCTION MATERIALS LABORATORY | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 4 | 2 |

**OBJECTIVE:**

- To facilitate the understanding of the behavior of construction materials.

**I. TEST ON FINE AGGREGATES** **15**

1. Grading of fine aggregates
2. Test for specific gravity and test for bulk density
3. Compacted and loose bulk density of fine aggregate

**II. TEST ON COARSE AGGREGATE** **15**

1. Determination of impact value of coarse aggregate
2. Determination of elongation index
3. Determination of flakiness index
4. Determination of aggregate crushing value of coarse aggregate

**III. TEST ON CONCRETE** **15**

1. Test for Slump
2. Test for Compaction factor
3. Test for Compressive strength - Cube & Cylinder
4. Test for Flexural strength

**IV. TEST ON BRICKS AND BLOCKS** **15**

2. Test for compressive strength of bricks and blocks
3. Test for Water absorption of bricks and blocks
4. Determination of Efflorescence of bricks
5. Test on tiles

**TOTAL: 60 PERIODS**

**OUTCOME:**

- The students will have the required knowledge in the area of testing of constructionmaterials and components of construction elements experimentally.

**REFERENCES:**


1. Construction Materials Laboratory Manual, Anna University, Chennai-600 025.
2. IS 4031 (Part 1) – 1996 – Indian Standard Method for determination of fineness bydrysieving.
3. IS 2386 (Part 1 to Part 6) – 1963 – Indian Standard methods for test for aggregate forconcrete
4. IS 383 – 1970 Indian Standard specification for coarse and fine aggregates from naturalsources for concrete.

| 21MA1404 | NUMERICAL METHODS | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**OBJECTIVES**

- To introduce the basic concepts of solving algebraic and transcendental equations.
- To introduce the numerical techniques of interpolation in various intervals in real life situations.
- To acquaint the student with understanding of numerical techniques of differentiation and integration, this plays an important role in engineering and technology disciplines.
- To acquaint the knowledge of various techniques and methods of solving ordinary differential equations.
- To understand the knowledge of various techniques and methods of solving various types of partial differential equations.

**UNIT 1 SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS** 12

Solution of algebraic and transcendental equations : Fixed point theorem (without proof)– Newton Raphson method - Solution of linear system of equations : Gauss elimination method - Gauss Jordan method - Iterative methods : Gauss Jacobi and Gauss Seidel - Eigen values of a matrix by Power method.

**UNIT II INTERPOLATION AND APPROXIMATION** 12

Interpolation with unequal intervals: Lagrange's interpolation – Newton's divided difference interpolation – Interpolation with equal intervals: Newton's forward and backward difference formulae.

**UNIT III NUMERICAL DIFFERENTIATION AND INTEGRATION** 12

Approximation of derivatives using interpolation polynomials - Numerical integration using Trapezoidal, Simpson's 1/3 rule – Evaluation of double integrals by Trapezoidal and Simpson's 1/3 rules.

**UNIT IV INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS**

12

Single step methods : Taylor's series method - Euler's method - Modified Euler's method – Improved Euler's method- Fourth order Runge - Kutta method for solving first order equations - Multi step methods : Milne's predictor corrector method for solving first order equations

**UNIT V BOUNDARY VALUE PROBLEMS IN ORDINARY AND PARTIAL DIFFERENTIALEQUATIONS** 12

Finite difference methods for solving second order ODE - Five point formula -Finite difference techniques for the solution of two dimensional Laplace's and Poisson's equations – One dimensional heat flow equation by explicit and implicit methods – One dimensional wave equation by explicit method.

**TOTAL: 60 PERIODS**

**OUTCOMES:**

1. Understand the basic concepts and techniques of solving algebraic and transcendental equations.
2. Appreciate the numerical techniques of interpolation and error approximations in various intervals in real life situations.
3. Apply the numerical techniques of differentiation and integration for engineering problems.
4. Apply the numerical techniques of integration for engineering problems.
5. Understand the knowledge of various techniques and methods for solving first and second

order ordinary differential equations.
6. Solve the partial and ordinary differential equations with initial and boundary conditions by using certain techniques with engineering applications.

**TEXT BOOKS:**


1. Burden, R.L and Faires, J.D, "Numerical Analysis", 9th Edition, Cengage Learning, 2016. Grewal, B.S., and Grewal, J.S., "Numerical Methods in Engineering and Science", KhannaPublishers, 10th Edition, New Delhi, 2015.
2. REFERENCES:
3. Kandasamy, P., Thilagavathy ,K.,and Gunavathy,S., 'Numerical Methods', Chand and Co.,2007.Brian Bradie, "A Friendly Introduction to Numerical Analysis", Pearson Education, Asia, New Delhi, 2007.
4. Gerald. C. F. and Wheatley. P. O., "Applied Numerical Analysis", Pearson Education, Asia, 6thEdition, New Delhi, 2006.
5. Mathews, J.H. "Numerical Methods for Mathematics, Science and Engineering", 2nd Edition,Prentice Hall, 1992.
6. SankaraRao. K., "Numerical Methods for Scientists and Engineers", Prentice Hall of India Pvt.Ltd, 3rd Edition, New Delhi, 2007.
7. Sastry, S.S, "Introductory Methods of Numerical Analysis", PHI Learning Pvt. Ltd, 5th Edition,2015.


**REFERENCES:**


1. Kandasamy, P., Thilagavathy ,K.,and Gunavathy,S., 'Numerical Methods', Chand and Co.,2007.
2. Brian Bradie, "A Friendly Introduction to Numerical Analysis", Pearson Education, Asia, New Delhi, 2007.
3. Gerald. C. F. and Wheatley. P. O., "Applied Numerical Analysis", Pearson Education, Asia, 6th Edition, New Delhi, 2006.
4. Mathews, J.H. "Numerical Methods for Mathematics, Science and Engineering", 2nd Edition, Prentice Hall, 1992.
5. SankaraRao. K., "Numerical Methods for Scientists and Engineers", Prentice Hall of India Pvt. Ltd, 3rd Edition, New Delhi, 2007.
6. Sastry, S.S, "Introductory Methods of Numerical Analysis", PHI Learning Pvt. Ltd, 5th Edition, 2015.

| 21CE1401 | ENVIRONMENTAL ENGINEERING - I | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**OBJECTIVE:**

- To equip the students with the principles and design of water treatment units and distribution system.

**UNIT I SOURCES OF WATER 9**

Public water supply system – Planning, Objectives, Design period, Population forecasting; Water demand – Sources of water and their characteristics, Surface and Groundwater – Impounding Reservoir – Development and selection of source – Source Water quality – Characterization – Significance – Drinking Water quality standards.

**UNIT II CONVEYANCE FROM THE SOURCE 9**

Water supply – intake structures – Functions; Pipes and conduits for water – Pipe materials – Hydraulics of flow in pipes – Transmission main design – Laying, jointing and testing of pipes – appurtenances – Types and capacity of pumps – Selection of pumps and pipe materials.

**UNIT III WATER TREATMENT** 9

Objectives – Unit operations and processes – Principles, functions, and design of water treatment plant units, aerators of flash mixers, Coagulation and flocculation – Clarifloccuator-Plate and tubesettlers - Pulsator clarifier - sand filters - Disinfection - Residue Management –Construction, Operation and Maintenance aspects.

**UNIT IV ADVANCED WATER TREATMENT 9**

Water softening – Desalination- R.O. Plant – demineralization – Adsorption - Ion exchange– Membrane Systems – RO Reject Management - Iron and Manganese removal - Construction and Operation & Maintenance aspects – Recent advances - MBR process.

**UNIT V WATER DISTRIBUTION AND SUPPLY 9**

Requirements of water distribution – Components – Selection of pipe material – Service reservoirs– Functions – Network design – Economics – Analysis of distribution networks –Computer applications – Appurtenances – Leak detection. Principles of design of water supply in buildings – House service connection –Fixtures and fittings, systems of plumbing and types of plumbing.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

The students completing the course will have

1. An insight into the structure of drinking water supply systems, including water transport, treatment and distribution
2. the knowledge in various unit operations and processes in water treatment
3. an ability to design the various functional units in water treatment

4. An understanding of water quality criteria and standards, and their relation to public health
5. The ability to design and evaluate water supply project alternatives on basis of chosen criteria.

**TEXTBOOKS:**


1. Garg, S.K. Environmental Engineering, Vol.IKhanna Publishers, New Delhi, 2010.
2. Modi, P.N., Water Supply Engineering, Vol.I Standard Book House, New Delhi, 2010.
3. Punmia, B.C.,Ashok Jain and Arun Jain, Water Supply Engineering, Laxmi Publications
   (P) Ltd., New Delhi, 2014.


**REFERENCES:**


1. Manual on Water Supply and Treatment, CPHEEO, Ministry of Urban Development,Government of India, New Delhi, 1999.
2. Syed R. Qasim and Edward M. Motley Guang Zhu, Water Works Engineering Planning,Design and Operation, Prentice Hall of India Learning Private Limited, New Delhi, 2009.

| 21CE1402 | APPLIED HYDRAULIC ENGINEERING | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**OBJECTIVE:**

- To introduce the students to various hydraulic engineering problems like open channel flows and hydraulic machines. At the completion of the course, the student should be able to relate the theory and practice of problems in hydraulic engineering.

**UNIT I UNIFORM FLOW** **9**

Definition and differences between pipe flow and open channel flow - Types of Flow - Properties of open channel - Velocity distribution in open channel - Steady uniform flow: Chezy equation, Manning equation - Best hydraulic sections for uniform flow – Wide open channel - Specific energy and specific force – Critical flow .

**UNIT II GRADUALLY VARIED FLOW** **9**

Dynamic equations of gradually varied flows – Types of flow profiles - Classifications: Computation by Direct step method and Standard step method – Control section – Break in Grade – Computation.

**UNIT III RAPIDLY VARIED FLOW** **9**

Application of the momentum equation for RVF - Hydraulic jumps - Types - Energy dissipation –Celerity – Rapidly varied unsteady flows (positive and negative surges)

**UNIT IV TURBINES** **9**

Impact of Jet on flat, curved plates, Stationary and Moving –Classification of Turbines – Pelton wheel – Francis turbine – Kaplan turbine - Specific speed – Characteristic Curves of Turbines- Draft tube and cavitation.

**UNIT V PUMPS** **9**

Classification of Pumps - Centrifugal pumps – Work done - Minimum speed to start the pump - NPSH - Multistage pumps – Characteristics curve - Reciprocating pumps - Negative slip - Indicator diagrams and its variations – Air vessels - Savings in work done.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

On completion of this course the students will be able to

- Apply their knowledge of fluid mechanics in addressing problems in open channels.
- Able to identify a effective section for flow in different cross sections.
- To solve problems in uniform, gradually and rapidly varied flows in steady state conditions.
- Understand the principles, working and application of turbines.
- Understand the principles, working and application of pumps.

**TEXTBOOKS:**


1. Subramanya.K ,"Flow in open channels", Tata McGraw Hill, New Delhi, 2000.
2. Modi P.N and Seth.S.M "Hydraulics and Fluid Mechanics including Hydraulic

Machines",Standard Book House New Delhi, 2009.
3. Chandramouli P.N.,"Applied Hydraulic Engineering", Yes Dee Publishing Pvt. Ltd., 2017.

**REFERENCES:**

1. Ven Te Chow, "Open Channel Hydraulics", McGraw Hill, New York, 2009.
2. Hanif Chaudhry.M., "Open Channel Flow", Second Edition, Springer, 2007.
3. Rajesh Srivastava, "Flow through open channels", Oxford University Press, New Delhi,2008.
4. Jain.A.K., " Fluid Mechanics" (Including Hydraulic Machines), Khanna Publishers, TwelfthEdition, 2016.
5. Subramanya.K., " Fluid Mechanics and Hydraulic Machines", Tata McGraw Hill EducationPrivate Limited, New Delhi, 2010.

| 21CE1403 | STRUCTURAL ANALYSIS - I | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**OBJECTIVE:**

- To introduce the students to basic theory and concepts of classical methods of structural analysis

**UNITI STRAIN ENERGY METHOD** **9**

Determination of Static and Kinematic Indeterminacies – Analysis of continuous beams, plane frames and indeterminate plane trusses by strain energy method (up to two degree of redundancy).

**UNITII SLOPE DEFLECTION METHOD** **9**

Slope deflection equations – Equilibrium conditions - Analysis of continuous beams and rigid frames – Rigid frames with inclined members - Support settlements- symmetric frames with symmetric and skew-symmetric loadings.

**UNITIII MOMENT DISTRIBUTION METHOD** **9**

Stiffness and carry over factors – Distribution and carryover of moments - Analysis of continuous Beams- Plane rigid frames with and without sway – Support settlement - symmetric frames withsymmetric and skew-symmetric loadings.

**UNITIV FLEXIBLITY METHOD** **9**

Primary structures - Compatibility conditions – Formation flexibility matrices - Analysis of indeterminate pin- jointed plane frames, continuous beams and rigid jointed plane frames by direct flexibility approach.

**UNITV STIFFNESS METHOD** **9**

Restrained structure –Formation of stiffness matrices - equilibrium condition - Analysis of Continuous Beams, Pin-jointed plane frames and rigid frames by direct stiffness method.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

Students will be able to

- Analyze continuous beams, pin-jointed indeterminate plane frames and rigid plane framesby strain energy method
- Analyse the continuous beams and rigid frames by slope defection method.
- Understand the concept of moment distribution and analysis of continuous beams and rigidframes with and without sway.
- Analyse the indeterminate pin jointed plane frames continuous beams and rigid framesusing matrix flexibility method.
- Understand the concept of matrix stiffness method and analysis of continuous beams, pinjointed trusses and rigid plane frames.

**TEXTBOOKS:**


1. Bhavikatti, S.S,Structural Analysis,Vol.1,& 2, Vikas Publishing House Pvt.Ltd.,NewDelhi-4,2014.
2. Bhavikatti, S.S, Matrix Method of Structural Analysis, I. K. International Publishing HousePvt.Ltd.,New Delhi-4, 2014.

3. Vazrani.V.N And Ratwani, M.M, Analysis of Structures, Vol.II, Khanna Publishers, 2015.
4. Pandit G.S.andGupta S.P.,Structural Analysis–AMatrix Approach, Tata McGraw HillPublishing Company Ltd.,2006

**REFERENCES:**

1. Punmia. B.C, Ashok Kumar Jain & Arun Kumar Jain, Theory of structures, LaxmiPublications, New Delhi, 2004.
2. William Weaver, Jrand James M.Gere, Matrix analysis of framed structures, CBSPublishers & Distributors, Delhi,1995
3. Hibbeler, R.C.,Structural Analysis, VII Edition, Prentice Hall, 2012.
4. Reddy.C.S, "Basic Structural Analysis",Tata McGraw Hill Publishing Company,2005.
5. Rajasekaran. S, & G. Sankarasubramanian., "Computational Structural Mechanics", PHILearning Pvt. Ltd, 2015
6. Negi L.S.and Jangid R.S.,Structural Analysis, Tata McGraw Hill Publishing Co.Ltd.2004.

| 21CE1404 | SOIL MECHANICS | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**OBJECTIVE:**

- To impart knowledge to classify the soil based on index properties and to assess their engineering properties based on the classification. To familiarize the students about the fundamental concepts of compaction, flow through soil, stress transformation, stress distribution, consolidation and shear strength of soils. To impart knowledge of design of both finite and infinite slopes.

**UNIT I SOIL CLASSIFICATION AND COMPACTION 9**

History – formation and types of soil – composition - Index properties – clay mineralogy structural arrangement of grains – description – Classification – BIS – US –phase relationship – Compaction– theory – laboratory and field technology – field Compaction method – factors influencing compaction.

**UNIT II EFFECTIVE STRESS AND PERMEABILITY 9**

Soil - water – Static pressure in water - Effective stress concepts in soils – Capillary phenomena– Permeability – Darcy's law – Determination of Permeability – Laboratory Determination (Constant head and falling head methods) and field measurement pumping out in unconfined and confined aquifer – Factors influencing permeability of soils – Seepage - Two dimensional flow – Laplace's equation – Introduction to flow nets –Simple problems Sheet pile and wier.

**UNIT III STRESS DISTRIBUTION AND SETTLEMENT 9**

Stress distribution in homogeneous and isotropic medium – Boussines of theory – (Point load, Line load and udl) Use of Newmarks influence chart –Components of settlement – Immediate and consolidation settlement – Factors influencing settlement – Terzaghi's one dimensional consolidation theory – Computation of rate of settlement. – √t and log t methods. e-log p relationship consolidation settlement N-C clays – O.C clays – Computation.

**UNIT IV SHEAR STRENGTH 9**

Shear strength of cohesive and cohesion less soils – Mohr-Coulomb failure theory – shear strength - Direct shear, Triaxial compression, UCC and Vane shear tests – Pore pressure parameters – Factors influences shear strength of soil.

**UNIT V SLOPE STABILITY 9**

Infinite slopes and finite slopes — Friction circle method – Use of stability number – Guidelines for location of critical slope surface in cohesive and c - soil – Slope protection measures.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

Students will be able to

- classify the soil and assess the engineering properties, based on index properties.
- Understand the stress concepts in soils
- Understand and identify the settlement in soils.

- Determine the shear strength of soil
- Analyze both finite and infinite slopes.

**TEXTBOOKS:**


1. Murthy, V.N.S., "Text book of Soil Mechanics and Foundation Engineering", CBSPublishers Distribution Ltd., New Delhi. 2014
2. Arora, K.R., "Soil Mechanics and Foundation Engineering", Standard Publishers andDistributors, New Delhi, 7th Edition, 2017(Reprint).
3. Gopal Ranjan, A S R Rao, "Basic and Applied Soil Mechanics" New Age InternationalPublication, 3rd Edition, 2016.
4. Punmia, B.C., "Soil Mechanics and Foundations", Laxmi Publications Pvt. Ltd. New Delhi,16th Edition, 2017.


**REFERENCES:**


1. McCarthy, D.F., "Essentials of Soil Mechanics and Foundations: Basic Geotechnics".Prentice-Hall, 2006.
2. Coduto, D.P., "Geotechnical Engineering – Principles and Practices", Prentice Hall of IndiaPvt. Ltd. New Delhi, 2010.
3. Braja M Das, "Principles of Geotechnical Engineering", Cengage Learning India PrivateLimited, 8th Edition, 2014.
4. Palanikumar.M., "Soil Mechanics", Prentice Hall of India Pvt. Ltd, Learning Private LimitedDelhi, 2013.
5. Craig.R.F., "Soil Mechanics", E & FN Spon, London and New York, 2012.
6. Purushothama Raj. P., "Soil Mechanics and Foundations Engineering",2nd Edition, PearsonEducation, 2013.
7. Venkatramaiah.C., "Geotechnical Engineering", New Age International Pvt. Ltd., New Delhi,2017

| 21CE1405 | SURVEYING | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**OBJECTIVES :**

- To introduce the rudiments of plane surveying and geodetic principles to Civil Engineers.
- To learn the various methods of plane and geodetic surveying to solve the real world Civil Engineering problems.
- To introduce the concepts of Control Surveying
- To introduce the basics of Astronomical Surveying

**UNIT I FUNDAMENTALS OF CONVENTIONAL SURVEYING AND LEVELLING** **9**

Classifications and basic principles of surveying - Equipment and accessories for ranging and chaining - Methods of ranging - Compass - Types of Compass - Basic Principles- Bearing – Types - True Bearing - Magnetic Bearing - Levelling- Principles and theory of Levelling – Datum- Bench Marks – Temporary and Permanent Adjustments- Methods of Levelling- Booking – Reduction - Sources of errors in Levelling - Curvature and refraction.

**UNIT II THEODOLITE AND TACHEOMETRIC SURVEYING** **9**

Horizontal and vertical angle measurements - Temporary and permanent adjustments - Heights and distances - Tacheometer - Stadia Constants - Analytic Lens -Tangential and Stadia Tacheometry surveying - Contour – Contouring – Characteristics of contours – Methods of contouring – Tacheometric contouring - Contour gradient – Uses of contour plan and map

**UNIT III CONTROL SURVEYING AND ADJUSTMENT** **9**

Horizontal and vertical control – Methods – specifications – triangulation- baseline – satellite stations – reduction to centre- trigonometrical levelling – single and reciprocal observations – traversing – Gale's table. - Errors Sources- precautions and corrections – classification of errors –true and most probable values - weighed observations – method of equal shifts – principle of least squares - normal equation – correlates- level nets- adjustment of simple triangulation networks.

**UNIT IV ADVANCED TOPICS IN SURVEYING** **9**

Hydrographic Surveying – Tides – MSL – Sounding methods – Three point problem – Strength of fix – astronomical Surveying – Field observations and determination of Azimuth by altitude and hour angle methods –.Astronomical terms and definitions - Motion of sun and stars - Celestial coordinate systems - different time systems - Nautical Almanac - Apparent altitude and corrections - Field observations and determination of time, longitude, latitude and azimuth by altitude and hour angle method.

**UNIT V MODERN SURVEYING** **9**

Total Station : Advantages - Fundamental quantities measured - Parts and accessories – working principle - On board calculations - Field procedure - Errors and Good practices in using Total Station GPS Surveying : Different segments - space, control and user segments - satellite configuration - signal structure -

**TOTAL : 45 PERIODS**

**OUTCOMES :**

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

- The use of various surveying instruments and mapping
- Measuring Horizontal angle and vertical angle using different instruments
- Methods of Leveling and setting Levels with different instruments
- Concepts of astronomical surveying and methods to determine time, longitude, latitude and azimuth
- Concept and principle of modern surveying.

**TEXT BOOKS :**


1. Kanetkar.T.P and Kulkarni.S.V, Surveying and Levelling, Parts 1 & 2, Pune Vidyarthi GrihaPrakashan, Pune, 2008
2. Punmia.B.C., Ashok K.Jain and Arun K Jain , Surveying Vol. I & II, Lakshmi PublicationsPvt Ltd, New Delhi, 2005
3. James M. Anderson and Edward M. Mikhail, "Surveying, Theory and Practice", 7th Edition,McGraw Hill, 2001.
4. Bannister and S. Raymond, "Surveying", 7th Edition, Longman 2004.
5. Laurila, S.H. "Electronic Surveying in Practice", John Wiley and Sons Inc, 1993
6. Venkatramaiah, Text book of Surveying, University press, New Delhi, 2014


**REFERENCES :**


1. Alfred Leick, “GPS satellite surveying”, John Wiley & Sons Inc., 3rd Edition, 2004.
2. Guocheng Xu, “GPS Theory , Algorithms and Applications”, Springer – Berlin, 2003.
3. SatheeshGopi, rasathishkumar, N. madhu, “Advanced Surveying, Total Station GPS andRemote Sensing” Pearson education, 2007
4. Roy S.K., "Fundamentals of Surveying", 2nd Edition, Prentice Hall of India, 2004.
5. Arora K.R.,"Surveying Vol I & II", Standard Book house, 10th Edition 2008.

| 21CE1411 | SURVEY PRACTICAL LABORATORY | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 4 | 2 |

**OBJECTIVE:**

- At the end of the course the student will possess knowledge about Survey field techniques

**LIST OF EXPERIMENTS:**

**Chain Survey**

1. Study of chains and its accessories, Aligning, Ranging, Chaining and Marking Perpendicular offset
2. Setting out works – Foundation marking using tapes single Room and Double Room

**Compass Survey**

3. Compass Traversing – Measuring Bearings & arriving included angles

**Levelling - Study of levels and levelling staff**

4. Fly levelling using Dumpy level &Tilting level
5. Check levelling

**Theodolite - Study of Theodolite**

6. Measurements of horizontal angles by reiteration and repetition and vertical angles
7. Determination of elevation of an object using single plane method when base is accessible/inaccessible.

**Tacheometry – Tangential system – Stadia system**

8. Determination of Tacheometric Constants
9. Heights and distances by stadia Tacheometry
10. Heights and distances by Tangential Tacheometry

**Total Station -** Study of Total Station, Measuring Horizontal and vertical angles

11. Traverse using Total station and Area of Traverse
12. Determination of distance and difference in elevation between two inaccessible pointsusing Total station

**TOTAL: 60 PERIODS**

**OUTCOME:**

- Students completing this course would have acquired practical knowledge on handling basic survey instruments including Theodolite, Tacheometry, Total Station and GPS and have adequate knowledge to carryout Triangulation and Astronomical surveying including general field marking for various engineering projects and Location of site etc.

**LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS**

| Sl.No. | Description of Equipment | Quantity |
|---|---|---|
| 1. | Total Station | 3 Nos |
| 2. | Theodolites | Atleast 1 for every 5 students |
| 3. | Dumpy level / Filling level | Atleast 1 for every 5 students |
| 4. | Pocket stereoscope | 1 |
| 5. | Ranging rods | 1 for a set of 5 students |
| 6. | Levelling staff | |
| 7. | Cross staff | |
| 8. | Chains | |
| 9. | Tapes | |
| 10. | Arrows | |
| 11. | Prismatic Compass | 10 nos |
| 12. | Surveyor Compass | 2 nos |
| 13. | Survey grade or Hand held GPS | 3 nos |

| 21CE1412 | HYDRAULIC ENGINEERING LABORATORY | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 4 | 2 |

**OBJECTIVE:**

- Students should be able to verify the principles studied in theory by performingthe experiments in lab.

**LIST OF EXPERIMENTS**

**A. Flow Measurement**

1. Calibration of Rotameter
2. Calibration of Venturimeter / Orificemeter
3. Bernoulli's Experiment

**B. Losses in Pipes**

4. Determination of friction factor in pipes
5. Determination of min or losses

**C. Pumps**

6. Characteristics of Centrifugal pumps
7. Characteristics of Gear pump
8. Characteristics of Submersible pump
9. Characteristics of Reciprocating pump

**D. Turbines**

10. Characteristics of Pelton wheel turbine
11. Characteristics of Francis turbine/Kaplan turbine

**E. Determination of Metacentric height**

12. Determination of Metacentric height of floating bodies

**TOTAL: 60 PERIODS**

**OUTCOMES:**

- The students will be able to measure flow in pipes and determine frictional losses.
- The students will be able to develop characteristics of pumps and turbines.

**REFERENCES:**


1. Sarbjit Singh."Experiments in Fluid Mechanics", Prentice Hall of India Pvt. Ltd, LearningPrivate Limited, Delhi, 2009.
2. "Hydraulic Laboratory Manual", Centre for Water Resources, Anna University, 2004.
3. Modi P.N. and Seth S.M., "Hydraulics and Fluid Mechanics", Standard Book House, NewDelhi, 2000.
4. Subramanya K. "Flow in open channels", Tata McGraw Hill Publishing.Company, 2001.


**LIST OF EQUIPMENTS**

1. One set up of Rotometer
2. One set up of Venturimeter/Orifice meter
3. One Bernoulli's Experiment set up

4. One set up of Centrifugal Pump
5. One set up of Gear Pump
6. One set up of Submersible pump
7. One set up of Reciprocating Pump
8. One set up of Pelton Wheel turbine
9. One set up of Francis turbines/one set of kaplon turbine
10. One set up of equipment for determination of Metacentric height of floating bodies
11. One set up for determination of friction factor in pipes
12. One set up for determination of minor losses.

| 21CE1413 | MINI PROJECT<br>(Activity Based - Subject Related) | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 2 | 1 |

**OBJECTIVE:**

- To use the knowledge acquired in Civil Engineering to do a mini project, which allows the students to come up with designs, fabrication or algorithms and programs expressing their ideas in a novel way.

**TOTAL: 60 PERIODS**

**STRATEGY**

To identify a topic of interest in consultation with Faculty/Supervisor. Review the literature and gather information pertaining to the chosen topic. State the objectives and develop a methodology to achieve the objectives. Carryout the design / fabrication or develop computer code. Demonstrate the novelty of the project through the results and outputs.

| 21HS1501 | PROFESSIONAL ETHICS | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**OBJECTIVES:**

- To instill Moral and Social Values and Loyalty and to appreciate the rights of others.

UNIT I **HUMAN VALUES** **10**

Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self-confidence – Character – Spirituality – Introduction to Yoga and meditation for professional excellence and stress management.

UNIT II **ENGINEERING ETHICS** **9**

Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg‟s theory – Gilligan‟s theory – Consensus and Controversy – Models of professional roles - Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories.

UNIT III **ENGINEERING AS SOCIAL EXPERIMENTATION** **9**

Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law.

UNIT IV **SAFETY, RESPONSIBILITIES AND RIGHTS** **9**

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk - Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination.

UNIT V **GLOBAL ISSUES** **8**

Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership –Code of Conduct – Corporate Social Responsibility.

**TOTAL :45 PERIODS**

**OUTCOMES:**

At the End of the Course, Learners will be able to Understand the:

- Human values related to Self-confidence, Commitment etc.
- Concepts of Engineering Ethics.
- Engineers as responsible Experimenters.
- Know the Intellectual Property Rights
- Understand the Global Issues

**TEXT BOOKS:**


1. Mike W. Martin and Roland Schinzinger, “Ethics in Engineering”, Tata McGraw Hill, NewDelhi, 2003.
2. Govindarajan M, Natarajan S, Senthil Kumar V. S, “Engineering Ethics”, Prentice Hall of India, New Delhi, 2004. 115


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1. Charles B. Fleddermann, “Engineering Ethics”, Pearson Prentice Hall, New Jersey, 2004.
2. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, “Engineering Ethics – Concepts and Cases”, Cengage Learning, 2009.
3. John R Boatright, “Ethics and the Conduct of Business”, Pearson Education, New Delhi, 2003
4. Edmund G Seebauer and Robert L Barry, “Fundamentals of Ethics for Scientists and Engineers”, Oxford University Press, Oxford, 2001.
5. Laura P. Hartman and Joe Desjardins, “Business Ethics: Decision Making for Personal Integrity and Social Responsibility” Mc Graw Hill education, India Pvt. Ltd.,New Delhi, 2013.
6. World Community Service Centre, „Value Education“, Vethathiri publications, Erode, 2011.


**Web sources:**

1. www.onlineethics.org
2. www.nspe.org
3. www.globalethics.org

| 21CE1501 | FOUNDATION ENGINEERING | L | T | P | C |
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**OBJECTIVES:**

- To impart knowledge to plan and execute a detail site investigation programme, to select geotechnical design parameters and type of foundations. Also to familiarize the students for the geotechnical design of different type of foundations and retaining walls.

**UNIT I SITE INVESTIGATION AND SELECTION OF FOUNDATION 9**

Scope and objectives – Methods of exploration – Auguring and boring – Wash boring and rotary drilling – Depth and spacing of bore holes – Soil samples – Representative and undisturbed – Sampling methods – Split spoon sampler, Thin wall sampler, Stationary piston sampler – Penetration tests (SPT and SCPT) – Data interpretation - Strength parameters - Bore log report and Selection of foundation.

**UNIT II SHALLOW FOUNDATION 9**

Location and depth of foundation – Codal provisions – Bearing capacity of shallow foundation on homogeneous deposits – Terzaghi's formula and BIS formula – Factors affecting bearing capacity – Bearing capacity from in-situ tests (SPT, SCPT and plate load) – Allowable bearing pressure – Seismic considerations in bearing capacity evaluation. Determination of Settlement of foundations on granular and clay deposits – Total and differential settlement – Allowable settlements – Codal provision – Methods of minimizing total and differential settlements.

**UNIT III FOOTINGS AND RAFTS 9**

Types of Isolated footing, Combined footing, Mat foundation – Contact pressure and settlement distribution – Proportioning of foundations for conventional rigid behaviour – Minimum thickness for rigid behaviour – Applications – Compensated foundation – Codal provision

**UNIT IV PILE FOUNDATION 9**

Types of piles and their functions – Factors influencing the selection of pile – Carrying capacity of single pile in granular and cohesive soil – Static formula – Dynamic formulae (Engineering news and Hileys) – Capacity from insitu tests (SPT and SCPT) – Negative skin friction – Uplift capacity-Group capacity by different methods (Feld's rule, Converse – Labarra formula and block failure criterion) – Settlement of pile groups – Interpretation of pile load test (routine test only), Under reamed piles – Capacity under compression and uplift – Cohesive – expansive – non expansive – Cohesion less soils – Codal provisions.

**UNIT V RETAINING WALLS 9**

Plastic equilibrium in soils – Active and passive states – Rankine's theory – Cohesion less and cohesive soil –Coulomb's wedge theory – Condition for critical failure plane – Earth pressure on retaining walls of simple configurations – Culmann's Graphical method – Pressure on the wall due to line load – Stability analysis of retaining walls – Codal provisions.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

Students will be able to

- Understand the site investigation, methods and sampling.
- Get knowledge on bearing capacity and testing methods.
- Design shallow footings.
- Determine the load carrying capacity, settlement of pile foundation.
- Determine the earth pressure on retaining walls and analysis for stability.

**TEXTBOOKS:**

1. Murthy, V.N.S., "Text book of Soil Mechanics and Foundation Engineering", CBS Publishers Distribution Ltd., New Delhi. 2014.
2. Gopal Ranjan, A.S.R Rao, "Basic and Applied Soil Mechanics", New Age International Publication, 3rd Edition, 2016.
3. Arora, K.R., "Soil Mechanics and Foundation Engineering", Standard Publishers and Distributors, New Delhi, 7th Edition, 2017 (Reprint).
4. Punmia, B.C., "Soil Mechanics and Foundations", Laxmi Publications Pvt. Ltd. New Delhi, 16th Edition 2017.
5. Venkatramaiah. C., "Geotechnical Engineering", New Age International Pvt. Ltd., New Delhi, 2017

**REFERENCES:**

1. Braja M Das, "Principles of Foundation Engineering" (Eigth edition), Cengage Learning 2014.
2. Kaniraj, S.R. "Design aids in Soil Mechanics and Foundation Engineering", Tata McGraw Hill publishing company Ltd., New Delhi, 2014.
3. Joseph E bowles, "Foundation Analysis and design", McGraw Hill Education, 5th Edition, 28th August 2015.
4. IS Code 6403 : 1981 (Reaffirmed 1997) "Bearing capacity of shallow foundation", Bureau of Indian Standards, New Delhi.
5. IS Code 8009 (Part 1):1976 (Reaffirmed 1998) "Shallow foundations subjected to symmetrical static vertical loads", Bureau of Indian Standards, New Delhi.
6. IS Code 8009 (Part 2):1980 (Reaffirmed 1995) "Deep foundations subjected to symmetrical static vertical loading", Bureau of Indian Standards, New Delhi.
7. IS Code 2911 (Part 1): 1979 (Reaffirmed 1997) "Concrete Piles" Bureau of Indian Standards, New Delhi.
8. IS Code 2911 (Part 2): 1979 (Reaffirmed 1997) "Timber Piles", Bureau of Indian Standards, New Delhi.
9. IS Code 2911 (Part 3) : 1979 (Reaffirmed 1997) "Under Reamed Piles", Bureau of Indian Standards, New Delhi.
10. IS Code 2911 (Part 4) : 1979 (Reaffirmed 1997) "Load Test on Piles", Bureau of Indian Standards, New Delhi.
11. IS Code 1904: 1986 (Reaffirmed 1995) "Design and Construction of Foundations in Soils", Bureau of Indian Standards, New Delhi.
12. IS Code 2131: 1981 (Reaffirmed 1997) "Method for Standard Penetration test for Soils", Bureau of Indian Standards, New Delhi.
13. IS Code 2132: 1986 (Reaffirmed 1997) "Code of Practice for thin – walled tube sampling for soils", Bureau of Indian Standards, New Delhi.
14. IS Code 1892 (1979): Code of Practice for subsurface Investigation for Foundations. Bureau of Indian Standards, New Delhi.
15. IS Code 14458 (Part 1) : 1998 "Retaining Wall for Hill Area – Guidelines, Selection of Type of Wall" , Bureau of Indian Standards, New Delhi.
16. IS Code 14458 (Part 2) : 1998 "Retaining Wall for Hill Area – Guidelines, Design of Retaining/Breast Walls" , Bureau of Indian Standards, New Delhi.
17. IS Code 14458 (Part 3) : 1998 "Retaining Wall for Hill Area – Guidelines, Construction Of Dry Stone Walls" , Bureau of Indian Standards, New Delhi.

| 21CE1502 | STRUCTURAL ANALYSIS - II | L | T | P | C |
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**OBJECTIVES:**

- To learn the method of drawing influence lines and its uses in various applications like beams and plane trusses.
- To analyse the arches, suspension bridges and space trusses.
- Also to learn Plastic analysis of beams and rigid frames.

**UNITI INFLUENCE LINES FOR DETERMINATE BEAMS 9**

Influence lines for reactions in statically determinate beams – Influence lines for shear force and bending moment – Calculation of critical stress resultants due to concentrated and distributed moving loads – absolute maximum bending moment - influence lines for member forces in pin jointed plane frames.

**UNITII INFLUENCE LINES FOR INDETERMINATE BEAMS 9**

Muller Breslau's principle– Influence line for Shearing force, Bending Moment and support reaction components of propped cantilever, continuous beams (Redundancy restricted to one), and fixed beams.

**UNITIII ARCHES 9**

Arches - Types of arches – Analysis of three hinged, two hinged and fixed arches - Parabolic and circular arches – Settlement and temperature effects.

**UNITIV CABLES AND SUSPENSION BRIDGES 9**

Equilibrium of cable – length of cable - anchorage of suspension cables – stiffening girders - cables with three hinged stiffening girders – Influence lines for three hinged stiffening girders.

**UNITV PLASTIC ANALYSIS 9**

Plastic theory - Statically indeterminate structures – Plastic moment of resistance – Plastic modulus – Shape factor – Load factor – Plastic hinge and mechanism – collapse load - Static and kinematic methods – Upper and lower bound theorems - Plastic analysis of indeterminate beams and frames.

**TOTAL:45PERIODS**

**OUTCOMES:**

Students will be able to

- Draw influence lines for statically determinate structures and calculate critical stress resultants.
- Understand Muller Breslau principle and draw the influence lines for statically indeterminate beams.
- Analyse of three hinged, two hinged and fixed arches.
- Analyse the suspension bridges with stiffening girders
- Understand the concept of Plastic analysis and the method of analyzing beams and rigid frames.

**TEXTBOOKS:**


1. Bhavikatti,S.S, Structural Analysis,Vol.1 & 2, Vikas Publishing House Pvt.Ltd., NewDelhi-4, 2014.
2. Punmia.B.C, Ashok Kumar Jain and Arun Kumar Jain, Theory of structures, Laxmi, Publications,2004.
3. Vazrani.V.N And Ratwani,M.M, Analysis of Structures, Vol.II, Khanna Publisers,2015.

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**REFERENCES:**


1. Negi.L.S and Jangid R.S., Structural Analysis, Tata McGraw-Hill Publishers, 2004.
2. Reddy C.S., Basic Structural Analysis, Tata McGraw Hill Publishing Co.Ltd.2002.
3. Gambhir.M.L., Fundamentals of Structural Mechanics and Analysis, PHIL earning Pvt. Ltd.,2011.
4. Prakash Rao D.S., Structural Analysis, Universities Press,1996.

| 21CE1503 | ENVIRONMENTAL ENGINERING - II | L | T | P | C |
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**OBJECTIVE:**

- The objectives of this course is to help students develop the ability to apply basic understanding of physical, chemical, and biological phenomena for successful design, operation and maintenance of sewage treatment plants.

**UNIT I PLANNING AND DESIGN OF SEWERAGE SYSTEM 9**

Characteristics and composition of sewage-- population equivalent -Sanitary sewage flow estimation – Sewer materials – Hydraulics of flow in sanitary sewers – Sewer design – Storm drainage-Storm runoff estimation – sewer appurtenances – corrosion in sewers – prevention and control – sewage pumping-drainage in buildings-plumbing systems for drainage.

**UNIT II PRIMARY TREATMENT OF SEWAGE 9**

Objectives – Unit Operations and Processes – Selection of treatment processes –- Onsite sanitation - Septic tank- Grey water harvesting – Primary treatment – Principles, functions and design of sewage treatment units - screens - grit chamber-primary sedimentation tanks – Construction, Operation and Maintenance aspects.

**UNIT III SECONDARY TREATMENT OF SEWAGE 9**

Objectives – Selection of Treatment Methods – Principles, Functions, - Activated Sludge Process and Extended aeration systems -Trickling filters– Sequencing Batch Reactor(SBR) – Membrane Bioreactor - UASB – Waste Stabilization Ponds – - Other treatment methods -Reclamation and Reuse of sewage - Recent Advances in Sewage Treatment – Construction, Operation and Maintenance aspects.

**UNIT IV DISPOSAL OF SEWAGE 9**

Standards for– Disposal - Methods – dilution – Mass balance principle –Self-purification of river- Oxygen sag curve – deoxygenation and reaeration - Streeter–Phelps model - Land disposal – Sewage farming – sodium hazards - Soil dispersion system.

**UNIT V SLUDGE TREATMENT AND DISPOSAL 9**

Objectives - Sludge characterization – Thickening -Design of gravity thickener- Sludge digestion – Standard rate and High rate digester design- Biogas recovery – Sludge Conditioning and Dewatering – Sludge drying beds- ultimate residue disposal – recent advances.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

The students completing the course will have

- An ability to estimate sewage generation and design sewer system including sewage pumping stations
- The required understanding on the characteristics and composition of sewage, self-purification of streams
- An ability to perform basic design of the unit operations and processes that are used in sewage treatment
- Understand the standard methods for disposal of sewage.
- Gain knowledge on sludge treatment and disposal.

**TEXTBOOKS:**


1. Garg, S.K., Environmental Engineering Vol. II, KhannaPublishers,New Delhi, 2015.
2. Duggal K.N., "Elements of Environmental Engineering" S.Chand and Co. Ltd., New Delhi, 2014.
3, Punmia, B.C., Jain, A.K., and Jain.A.K.., Environmental Engineering, Vol.II, Laxmi Publications, 2010.


**REFERENCES:**


1. Manual on Sewerage and Sewage Treatment Systems Part A,B and C, CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 2013.

2. Metcalf and Eddy- Wastewater Engineering–Treatment and Reuse, Tata Mc.Graw-Hill Company, New Delhi, 2010.
3. Syed R. Qasim "Wastewater Treatment Plants", CRC Press, Washington D.C.,2010
4. Gray N.F, "Water Technology", Elsevier India Pvt. Ltd., New Delhi, 2006.

| 21CE1504 | DESIGN OF REINFORCED CEMENT CONCRETE STRUCTURES | L | T | P | C |
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**OBJECTIVES:**

- To introduce the different types of philosophies related to design of basic structural elements such as slab, beam, column and footing which form part of any structural system with reference to Indian standard code of practice.

**UNIT I INTRODUCTION 9**

Concept of Elastic method, ultimate load method and limit state method – Design of Singly and doubly reinforced beams by working stress method - Limit State philosophy as detailed in IS code - Advantages of Limit State Method over other methods - Analysis and design of singly and doubly reinforced rectangular beams by Limit State Method.

**UNIT II LIMIT STATE METHOD - FLANGED BEAM, SHEAR & TORSION 9**

Analysis and design of flanged beams – Use of design aids for Flexure - Behaviour of RC members in bond and Anchorage - Design requirements as per current code - Behaviour of RC beams in shear and torsion - Design of RC members for combined bending, shear and torsion.

**UNIT III LIMIT STATE DESIGN OF SLABS AND STAIRCASE 9**

Analysis and design of cantilever, one way, two way and continuous slabs subjected to uniformly distributed load for various boundary conditions- Types of Staircases – Design of dog-legged Staircase.

**UNIT IV LIMIT STATE DESIGN OF COLUMNS 9**

Types of columns – Braced and unbraced columns – Design of short Rectangular and circular columns for axial, uniaxial and biaxial bending.

**UNIT V LIMIT STATE DESIGN OF FOOTING 9**

Design of wall footing – Design of axially and eccentrically loaded rectangular pad and sloped footings – Design of combined rectangular footing for two columns only.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

Students will be able to

- Understand the various design methodologies for the design of RC elements.
- Know the analysis and design of flanged beams by limit state method and sign of beams for shear, bond and torsion.
- design the various types of slabs and staircase by limit state method.
- Design columns for axial, uniaxial and biaxial eccentric loadings.
- Design of footing by limit state method.

**TEXT BOOKS:**


1. Varghese, P.C., “Limit State Design of Reinforced Concrete”, Prentice Hall of India, Pvt. Ltd., New Delhi, 2002.
2. Gambhir.M.L., "Fundamentals of Reinforced Concrete Design", Prentice Hall of India Private Limited, New Delhi, 2006.
3. Subramanian,N.,”Design of Reinforced Concrete Structures”,Oxford University Press, New Delhi, 2013.
4. Krishnaraju.N “ Design of Reinforced Concrete Structurres “, CBS Publishers & Distributors Pvt. Ltd., New Delhi.
5. Ramachandra, “Limit state Design of Concrete Structures“ Standard Book House, New Delhi

**REFERENCES:**


1. Jain, A.K., “Limit State Design of RC Structures”, Nemchand Publications, Roorkee, 1998
2. Sinha, S.N., “Reinforced Concrete Design”, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2002
3. Unnikrishna Pillai, S., Devdas Menon, “Reinforced Concrete Design”, Tata McGraw Hill Publishing Company Ltd., 2009
4. Punmia.B.C., Ashok Kumar Jain, Arun Kumar Jain, “Limit State Design of Reinforced Concrete”,Laxmi Publication Pvt. Ltd., New Delhi, 2007.
5. Bandyopadhyay. J.N., "Design of Concrete Structures"., Prentice Hall of India Pvt. Ltd., New Delhi, 2008.
6. IS456:2000, Code of practice for Plain and Reinforced Concrete, Bureau of Indian Standards, New Delhi, 2000
7. SP16, IS456:1978 “Design Aids for Reinforced Concrete to Bureau of Indian Standards, New Delhi, 1999
8. Shah V L Karve S R., "Limit State Theory and Design of Reinforced Concrete", Structures Publilcations, Pune, 2013

| 21CE1511 | ENVIRONMENTAL ENGINEERING LABORATORY | L | T | P | C |
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**OBJECTIVES:**

- To understand the sampling and preservation methods and significance of characterization of wastewater.

**LIST OF EXPERIMENTS:**

1. Coagulation and Precipitation process for treating wastewater
2. Determination of suspended, volatile, fixed and settleable solids in wastewater
3. Determination of Phosphate in wastewater
4. Determination of Calcium, Potassium and Sodium
5. Determination of Heavy Metals – Chromium, Lead and Zinc (Demonstration only)
6. Determination of iron in water by AAS (Demonstration only)
7. Determination of Sulphate in Water
8. Determination of fluoride in water by Spectrophotometric method/ISE
9. Determination of BOD In wastewater
10. Determination of COD in wastewater
11. Determination of Nitrate in wastewater
12. Determination of Coliform (Demonstration only)
13. Identification of Bacteria by Gram Staining technique.

**TOTAL: 60 PERIODS**

**OUTCOMES:**

- The students completing the course will be able to characterize wastewater and conduct treatability studies

**REFERENCES:**

1. Standards Methods for the Examination of Water and Wastewater: 17th Edition, WPCF, APHA and AWWA, USA, 1989.

**LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS**

| S.No. | Description of Equipment | Quantity |
|---|---|---|
| 1. | Oxygen analyzer | 1 |
| 2. | Spectrophotometer | 1 |
| 3. | Ion-selective electrode | 1 |
| 4. | Sodium Pottasium Analyzer – Flame Photometer | 1 |
| 5. | Gas Chromatography | 1 |
| 6. | Atomic absorption Spectroscopy (Ni, Zn, Pb) | 1 |
| 7. | Nephio – turbidity meter | 1 |
| 8. | BOD Analyser | 1 |
| 9. | COD Analyser | 1 |
| 10. | Jar Test Apparatus | 1 |
| 11. | Compound Microscope | 1 |

| 21CE1512 | SOIL MECHANICS LABORATORY | L | T | P | C |
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**OBJECTIVES:**

To develop skills to test the soils for their index and engineering properties and to characterise the soil based on their properties.

**EXERCISES:**

**1. DETERMINATION OF INDEX PROPERTIES** **20**

a. Specific gravity of soil solids
b. Grain size distribution – Sieve analysis
c. Grain size distribution - Hydrometer analysis
d. Liquid limit and Plastic limit tests
e. Shrinkage limit and Differential free swell tests

**2. DETERMINATION OF INSITU DENSITY AND COMPACTION CHARACTERISTICS** **12**

a. Field density Test ( Sand replacement method and core cutter method)
b. Determination of moisture – density relationship using standard Proctor compaction test.
c. Determination of relative density (Demonstration only)

**3. DETERMINATION OF ENGINEERING PROPERTIES** **28**

a. Permeability determination (constant head and falling head methods)
b. One dimensional consolidation test (Determination of Co-efficient of consolidation only)
c. Direct shear test in cohesionless soil
d. Unconfined compression test in cohesive soil
e. Laboratory vane shear test in cohesive soil
f. Tri-axial compression test in cohesionless soil (Demonstration only)
g. California Bearing Ratio Test

**TOTAL: 60 PERIODS**

**OUTCOMES:**

- Students are able to conduct tests to determine both the index and engineering properties of soils and to characterize the soil based on their properties.

**REFERENCES:**


1. "Soil Engineering Laboratory Instruction Manual" published by Engineering College Cooperative Society, Anna University, Chennai, 2010.
2. Lambe T.W., "Soil Testing for Engineers", John Wiley and Sons, New York, 1951. Digitized 2008.
3. Saibaba Reddy, E.Ramasastri, K. "Measurement of Engineering Properties of Soils" New age International (P) Limited Publishers, New Delhi, 2002.
4. IS Code of Practice (2720) Relevant Parts, as amended from time to time, Bureau of Indian Standards, New Delhi.

## LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

| Sl.No. | Description of Equipment | Quantity |
|---|---|---|
| 1. | Sieves | 2 sets |
| 2. | Hydrometer | 2 sets |
| 3. | Liquid and Plastic limit apparatus | 2 sets |
| 4. | Shrinkage limit apparatus | 3 sets |
| 5. | Proctor Compaction apparatus | 2 sets |
| 6. | UTM of minimum of 20kN capacity | 1 |
| 7. | Direct Shear apparatus | 1 |
| 8. | Thermometer | 2 |
| 9. | Sand replacement method accessories and core cutter method accessories | 2 |
| 10. | Tri-axial Shear apparatus | 1 |
| 11. | Three Gang Consolidation test device | 1 |
| 12. | Relative Density apparatus | 1 |
| 13. | Van Shear apparatus | 1 |
| 14. | Weighing machine – 20kg capacity | 1 No |
| 15. | Weighing machine – 1kg capacity | 3 No |

| 21CE1601 | DESIGN OF STEEL STRUCTURAL ELEMENTS | L | T | P | C |
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**OBJECTIVES:**

To introduce the students to limit state design of structural steel members subjected to compressive, tensile and bending loads, including connections. Design of structural systems such as roof trusses, gantry girders as per provisions of current code (IS 800 - 2007) of practice for working stress and Limit state Method.

**UNIT I INTRODUCTION AND WORKING STRESS DESIGN 9**

Introduction - Properties of structural steel – Indian standard Structural steel sections - Code and specifications - Loads on Structures – Design approach – working stress Method – Analysis procedures and Design philosophy for Tension Member, Compression Member and Laterally supported Beam- Strength of section by working stress method in Tension, Compression for axial Load only– Beam - Resisting Moment - Deflection- Shear – Design of Beams for Flexure (Laterally supported Beam only)

**UNIT II STEEL CONNECTIONS 9**

Introduction to Limit state Design - Connections using rivets, welding, bolting – Design of bolted and welded joints – Eccentric connections - Efficiency of joints

**UNIT III TENSION MEMBERS 9**

Tension Members - Types of sections – Net area – Net effective sections for angles and Tee in tension – Design of connections in tension members – Use of lug angles – Design of tension splice – Concept of shear lag

**UNIT IV COMPRESSION MEMBERS 9**

Types of compression members – Theory of columns – Basis of current code provision for compression member design – Slenderness ratio – Design of single section and compound section compression members – Design of laced and battened type columns – Design of column bases – Gusseted base

**UNIT V BEAMS 9**

Design of laterally supported and unsupported beams – Built up beams – Beams subjected to uniaxial and biaxial bending – Design of plate girders - Intermediate and bearing stiffeners – Flange and web splices.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

Students will be able to

1. Understand the concepts of various design philosophies
2. Design common bolted and welded connections for steel structures
3. Design tension members and understand the effect of shear lag.
4. Understand the design concept of axially loaded columns and column base connections.
5. Understand specific problems related to the design of laterally restrained and unrestrained steel beams.

**TEXT BOOKS:**


1. Gambhir. M.L., "Fundamentals of Structural Steel Design", McGraw Hill Education India Pvt. Ltd., 2013
2. Sai Ram. K.S. “Design of Steel Structures “ Dorling Kindersley (India) Pvt. Ltd., New Delhi, 2nd Edition, 2015, www.pearsoned.co.in/kssairam
3. Shiyekar. M.R., "Limit State Design in Structural Steel", Prentice Hall of India Pvt. Ltd, Learning Pvt. Ltd., 2nd Edition, 2013.
4. Subramanian.N, "Design of Steel Structures", Oxford University Press, New Delhi, 2013.


**REFERENCES:**

1. Narayanan.R.et.al. "Teaching Resource on Structural Steel Design", INSDAG, Ministry of Steel Publications, 2002
2. Duggal. S.K, "Limit State Design of Steel Structures", Tata McGraw Hill Publishing Company, 2005
3. Bhavikatti.S.S, "Design of Steel Structures" By Limit State Method as per IS:800– 2007, IK International Publishing House Pvt. Ltd., 2009
4. Shah.V.L. and Veena Gore, "Limit State Design of Steel Structures", IS 800–2007, Structures Publications, 2009.
1. IS800 :2007, General Construction in Steel - Code of Practice, (Third Revision), Bureau of Indian Standards, New Delhi, 2007

| 21CE1602 | HIGHWAY ENGINEERING | L | T | P | C |
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**OBJECTIVES:**

- To give an overview about the highway engineering with respect to, planning, design, construction and maintenance of highways as per IRC standards, specifications and methods.

**UNIT I HIGHWAY PLANNING AND ALIGNMENT 9**

Significance of highway planning – Modal limitations towards sustainability - History of road development in India – Classification of highways – Locations and functions – Factors influencing highway alignment – Soil suitability analysis - Road ecology - Engineering surveys for alignment, objectives, conventional and modern methods.

**UNIT II GEOMETRIC DESIGN OF HIGHWAYS 9**

Typical cross sections of Urban and Rural roads — Cross sectional elements - Sight distances – Horizontal curves, Super elevation, transition curves, widening at curves – Vertical curves - Gradients, Special consideration for hill roads - Hairpin bends – Lateral and vertical clearance at underpasses.

**UNIT III DESIGN OF FLEXIBLE AND RIGID PAVEMENTS 9**

Design principles – pavement components and their role - Design practice for flexible and rigid Pavements (IRC methods only) – Embankments- Problems in Flexible pavement design.

**UNIT IV HIGHWAY CONSTRUCTION MATERIALS AND PRACTICE 9**

Highway construction materials, properties, testing methods – CBR Test for subgrade - tests on aggregate & bitumen – Test on Bituminous mixes-Construction practice including modern materials and methods, Bituminous and Concrete road construction, Polymer modified bitumen, Recycling, Different materials – Glass, Fiber, Plastic, Geo-Textiles, Geo-Membrane (problem not included) – Quality control measures - Highway drainage — Construction machineries.

**UNIT V EVALUATION AND MAINTENANCE OF PAVEMENTS 9**

Pavement distress in flexible and rigid pavements – Pavement Management Systems - Pavement evaluation, roughness, present serviceability index, skid resistance, structural evaluation, evaluation by deflection measurements – Strengthening of pavements –Types of maintenance – Highway Project formulation-Case Studies.

**TOTAL: 45 PERIODS**

**OUTCOMES:**

Students will be able to

1. Get knowledge on planning and aligning of highway.
2. Geometric design of highways
3. Design flexible and rigid pavements.
4. Gain knowledge on Highway construction materials, properties, testing methods
5. Understand the concept of pavement management system, evaluation of distress and maintenance of pavements.

**TEXTBOOKS:**


1. Khanna.S. K., Justo.C.E.G and Veeraragavan A. "Highway Engineering", Nemchand Publishers, 2014.
2. Subramanian K.P., "Highways, Railways, Airport and Harbour Engineering", Scitech Publications (India), Chennai, 2010
3. Kadiyali.L.R. "Principles and Practice of Highway Engineering", Khanna Technical Publications, 8th edition Delhi, 2013.


**REFERENCES:**

1. Indian Road Congress (IRC), Guidelines and Special Publications of Planning and Design.
2. Yang H. Huang, "Pavement Analysis and Design", Pearson Education Inc, Nineth Impression, South Asia, 2012
3. Ian D. Walsh, "ICE manual of highway design and management", ICE Publishers, Ist Edition, USA, 2011
4. Fred L. Mannering, Scott S. Washburn and Walter P.Kilareski, "Principles of Highway Engineering and Traffic Analysis", Wiley India Pvt. Ltd., New Delhi, 2011
5. Garber and Hoel, "Principles of Traffic and Highway Engineering", CENGAGE Learning, New Delhi, 2010
6. O'Flaherty.C.A "Highways, Butterworth – Heinemann, Oxford, 2006

| 21CE1611 | BUILDING AND STRUCTURAL ENGINEERING DRAWING | L | T | P | C |
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**OBJECTIVES:**

Objective of building drawing and drafting course is to introduce students the basic terminology, component and element of building drawing. This course is designed to familiarize the students with the fundamentals of building drawing and drafting skill. Emphasis is placed on drafting floor plan, elevation, section and details of building.

1. **Introduction to building and Building drawing (1 hour)**
    1. Structural system of building
    2. Anatomy of building
    3. Elements of building
    4. Scale of building drawing
2. **Symbols and conventional signs used for building drawing (1 hour)**
3. **Standard views used in building drawing (5 hours)**
    1. Location plan
    2. Site plan
    3. Floor plans
    4. Elevations/Facades
    5. Cross section
    6. Detail drawings
4. **Types of building drawing (7 hours)**
    1. Concept drawing
    2. Presentation drawing
    3. Municipality drawing
    4. Measured drawing
    5. Working drawing
        1. Architect's drawing
        2. Structural drawing
        3. Service drawing
        4. As built drawing
5. **Introduction to Building Bye-Laws (1 hour)**

**Drawing Sheet to be prepared by the students:**

| S.N | Description | Sheets | Hour |
|---|---|---|---|
| 1 | Load bearing and frame structure building, scale conversion, symbols and conventional signs | 2 | 8 |
| 2 | Floor plans | 1 | 8 |
| 3 | Elevations, cross sections | 1 | 8 |
| 4 | Details of building | 2 | 8 |
| 5 | Municipality drawing | 1 | 8 |
| 6 | Measured drawing | 1 | 5 |
| 7 | Working drawings (Architect's, structural, electrical, sanitary drawings etc) | 4 | 15 |
| **Total** | | **12** | 60 |

**Course Outcomes:**

On completion of the course, the student should be able to;

1. Draw the conventional signs and component parts of the residential building
2. Draw plan, cross section and elevation of Residential buildings of load bearing walls
3. Draw plan, cross section and elevation of Residential buildings of framed structures
4. Draw line diagrams of Public buildings.

**References:**


1. Building Bye-laws.
2. Suraj Singh."Civil Engineering Building practice"
3. "Metrix Architectural construction drafting and design fundamentals", Willian J. Hornung.
4. John Molnar "Building construction drafting and design"
5. Brian W. Boughton."Building and Civil engineering construction"
6. Hornung "Architectural Drafting, 5th edition"
7. John D. Bies. "Architectural drafting: Structure and Environment"
8. Thomas, Marvin L."Architectural Working Drawing"


| 21CE1612 | HIGHWAY ENGINEERING LABORATORY | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 4 | 2 |

**OBJECTIVES:**

- To learn the principles and procedures of testing of highway materials

**EXCERCISES:**

**1. TEST ON AGGREGATES**

a) Specific Gravity
b) Los Angeles Abrasion Test
c) Water Absorption of Aggregates

**2. TEST ON BITUMEN**

a) Specific Gravity of Bitumen
b) Penetration Test
c) Viscosity Test
d) Softening Point Test
e) Ductility Test

**3. TESTS ON BITUMINOUS MIXES**

a) Stripping Test
b) Determination of Binder Content
c) Marshall Stability and Flow Values

**4. DEMONSTRATION OF FIELD-TESTING EQUIPMENT**

**TOTAL: 60 PERIODS**

**OUTCOMES:**

- Student knows the techniques to characterize various pavement materials through relevant tests.

**REFERENCES:**


1. Highway Materials and Pavement Testing, Nem Chand and Bros., Roorkee, Revised Fifth Edition, 2009
2. Methods for testing tar and bituminous materials, IS 1201–1978 to IS 1220– 1978, Bureau of Indian Standards
3. Methods of test for aggregates, IS 2386 – 1978, Bureau of Indian Standards

4. Mix Design Methods Asphalt Institute Manual Series No. 2, Sixth Edition,1997, Lexington, KY, USA.

**LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS**

| Sl.No | Description of Equipment | Quantity |
|---|---|---|
| 1. | Concrete cube moulds | 6 |
| 2. | Concrete cylinder moulds | 3 |
| 3. | Concrete Prism moulds | 3 |
| 4. | Sieves | 1set |
| 5. | Concrete Mixer | 1 |
| 6. | Slump cone | 3 |
| 7. | Flow table | 1 |
| 8. | Vibrator | 1 |
| 9. | Trovels and planers | 1 set |
| 10. | UTM – 400 kN capacity | 1 |
| 11. | Vee Bee Consistometer | 1 |
| 12. | Aggregate impact testing machine | 1 |
| 13. | CBR Apparatus | 1 |
| 14. | Blains Apparatus | 1 |
| 15. | Los - Angeles abrasion testing machine | 1 |
| 16. | Marshall Stability Apparatus | 1 |

| 21CE1613 | SURVEY CAMP<br>(During VI semester 2 weeks) | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 0 | 1 |

The objective of the survey camp is to enable the students to get practical training in the field work. Groups of not more than six members in a group will carry out each exercise in survey camp. The camp must involve work on a large area of not less than 40 acres outside the campus (Survey camp should not be conducted inside the campus). At the end of the camp, each student shall have mapped and contoured the area. The camp record shall include all original field observations, calculations and plots.

Two weeks Survey Camp will be conducted during summer vacation in the following activities:

1. Traverse - using Total station
2. Contouring
   (i). Radial tachometric contouring - Radial Line at Every 45 Degree and Length not less than 60 Meter on each Radial Line
   (ii). Block Level/ By squares of size at least 100 Meter x 100 Meter atleat 20 Meter interval
   (III). L.S & C.S - Road and canal alignment for a Length of not less than 1 Kilo Meter atleast L.S at Every 30M and C.S at every 90 M
3. Offset of Buildings and Plotting the Location
4. Sun observation to determine azimuth
5. Use of GPS to determine latitude and longitude and locate the survey camp location
6. Traversing using GPS
7. Curve setting by deflection angle

Apart from above students may be given survey exercises in other area also based on site condition to give good exposure on survey.

| 21CE1614 | QUANTITATIVE APTITUDE AND BEHAVIOURAL SKILLS | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 2 | 1 |

**OBJECTIVES:**

- To set the attitude and behavioural of the students towards their goal
- To familiarize them with behavioural skills and professional etiquettes and communication.
- To create awareness and enhance students Quantitative Aptitude

**UNIT I SELF ESTEEM, ETIQUETTES AND GOAL SETTING 6**

Self-awareness, self-motivation, self-respect and self-learning - Building self-confidence - The development and factors motivating self-esteem - Etiquette - Common Social and professional etiquettes - Cell phone and email etiquette - Social media etiquette- The basics of effective goals – steps to be followed to obtain optimum results from goal setting – Identifying the reasons and Overcoming Procrastination – priority management at home and college.

**UNIT II COMMUNICATION 6**

Concept, characters and process of communication - 7c's of communication - Verbal and non verbal communication - Body language -Art of meeting and greeting- Making Effective conversation.

**UNIT III TIME AND ROOTS 6**

Square roots and Cube Roots, Surds and Indices, Time and Work, Time and Distance

**UNIT IV MEASUREMENTS 6**

Volume and Surface Area, Simple Interest, Compound Interest, Allegation or Mixture

**UNIT V CODING CONCEPTS 6**

Logarithms, Coding and Decoding, Cubes and Dice, Chain Rule

**TOTAL: 30 PERIODS**

**List of Activities**

1. Self-Analysis Activities
2. Role Play
3. Extempore
4. Classroom Teaching on Quantitative Aptitude
5. Practice sessions for Quantitative Aptitude

**COURSE OUTCOMES**

1. Develop self-esteem, social etiquettes and
2. Set professional goals
3. Communicate effectively in group conversations
4. Apply the concepts in the relative working environment
5. Solve the problems related to financial services and geometry
6. Interpret the coding ideas to enhance the programming skills

**Learning Resources -Online**

1. Positivepsychology.com
2. www.skillsyouneed.com
3. www. businessjargons.com
4. www.careerbless.com/aptitude/qa
5. www.indiabix.com/aptitude

**Text book References:**

1.Sherfield, R. M.; Montgomery, R.J. and Moody, P, G. (2010). Developing Soft Skills. 4th ed.
2.R.S.Agarwarl, S.Chand Publishing Quantitative Aptitude Latest Edition Paperback – 1 January 2018.

| 21CE1615 | IN-PLANT TRAINING<br>(2 Weeks – Summer) | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 0 | 2 |

**OBJECTIVE:**

- To train the students in field work so as to have a knowledge of practical problems in carrying out engineering tasks. To develop skills in facing and solving the field problems.

**STRATEGY:**

The students individually undertake training in reputed civil engineering companies for the specified duration At the end of the training, are port on the work done will be prepared and presented. The students will be evaluated through a viva-voce examination by a team of internal staff.

**OUTCOMES:**

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

- The intricacies of implementation textbook knowledge into practice
- The concepts of developments and implementation of new techniques

| 21HS1701 | TOTAL QUALITY MANAGEMENT | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**OBJECTIVES:**

To facilitate the understanding of Quality Management principles and process.

**UNIT I INTRODUCTION 9**

Introduction - Need for quality - Evolution of quality - Definitions of quality - Dimensions of product and service quality - Basic concepts of TQM - TQM Framework - Contributions of Deming, Juran and Crosby - Barriers to TQM - Customer focus - Customer orientation, Customer satisfaction, Customer complaints, Customer retention.

**UNIT II TQM PRINCIPLES 9**

Leadership - Quality Statements, Strategic quality planning, Quality Councils - Employee involvement - Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement - PDCA cycle, 5S, Kaizen - Supplier partnership - Partnering, Supplier selection, Supplier Rating.

**UNIT III TQM TOOLS AND TECHNIQUES I 9**

The seven traditional tools of quality - New management tools - Six sigma: Concepts, Methodology, applications to manufacturing, service sector including IT - Bench marking - Reason to bench mark, Bench marking process - FMEA - Stages, Types.

**UNIT IV TQM TOOLS AND TECHNIQUES II 9**

Quality Circles - Cost of Quality - Quality Function Deployment (QFD) - Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures.

**UNIT V QUALITY MANAGEMENT SYSTEM 9**

Introduction—Benefits of ISO Registration—ISO 9000 Series of Standards—Sector-Specific Standards—AS 9100, TS16949 and TL 9000-- ISO 9001 Requirements—Implementation—Documentation—Internal Audits—Registration--ENVIRONMENTAL MANAGEMENT SYSTEM: Introduction—ISO 14000 Series Standards—Concepts of ISO 14001—Requirements of ISO14001—Benefits of EMS.

TOTA : 45 PERIODS

**OUTCOMES:**

The student would be able to apply the tools and techniques of quality management to manufacturing and services processes.

**Text Books:**


1. Dale H.Besterfiled, Carol B.Michna,Glen H. Besterfield, Mary B.Sacre,Hemant Urdhwareshe and Rashmi Urdhwareshe, “Total Quality Management”, Pearson EducationAsia, Revised Third Edition, Indian Reprint, Sixth Impression, 2013.


**Reference Books:**


1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8 th Edition, First Indian Edition, Cengage Learning, 2012.
2. Janakiraman. B and Gopal .R.K., "Total Quality Management - Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006. 3. Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006. 4. ISO9001-2015 standards

| 21CE1701 | ESTIMATION, COSTING AND VALUATION ENGINEERING | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**OBJECTIVES:**

- The students will acquire knowledge in estimation, tender practices, contract procedures, and valuation and will be able to prepare estimates, call for tenders and execute works.

**UNIT I QUANTITY ESTIMATION 9**

Philosophy–Purpose–Methods of estimation–Types of estimates–Approximate estimates –Detailed estimate– Estimation of quantities for buildings, bituminous and cement concrete roads, septic tank, soak pit, retaining walls – culverts (additional practice in class room using computer software)

**UNIT II RATEANALYSISAND COSTING 9**

Standard Data–Observed Data–Schedule of rates–Market rates– Standard Data for Man Hours and Machineries for common civil works–Rate Analysis for all Building works, canals, and Roads–Cost Estimates (additional practice in class room using Computer softwares) - (Analysis of rates for the item of work asked, the data regarding labour, rates of material and rates of labour to be given in the Examination Question Paper)

**UNIT III SPECIFICATIONS, REPORTS AND TENDERS 9**

Specifications–Detailedandgeneralspecifications–Constructions–Sources– Types of specifications–Principles for report preparation – report on estimate of residential building – Culvert – Roads – TTTAct2000–Tender notices–types–tender procedures–Drafting model tenders,E-tendering-Digital signature certificates-Encrypting-Decrypting–Reverse auctions.

**UNIT IV CONTRACTS 9**

Contract–Types of contracts– Formation of contract– Contract conditions–Contract for labour, material, design, construction– Drafting of contract documents based on IBRD /MORTH Standard bidding documents– Construction contracts–Contract problems– Arbitration and legal requirements.

**UNIT V VALUATION 9**

Definitions–Various types of valuations–Valuation methods - Necessity – Capitalised value – Depreciation – Escalation – Valuation of land–Buildings – Calculation of Standard rent – Mortgage – Lease

**TOTAL: 45 PERIODS**

**OUTCOMES:**

The student will be able to

1. Estimate the quantities for buildings,
2. Rate Analysis for all Building works, canals, and Roads and Cost Estimate.
3. Understandtypes of specifications, principles for report preparation, tender notices types.
4. Gain knowledge on types of contracts
5. Evaluate valuation for building and land.

**TEXTBOOKS:**


1. B.N Dutta 'Estimating and Costing in Civil Engineering', UBS Publishers & Distributors (P) Ltd, 2010.
2. B.S.Patil, 'Civil Engineering Contracts and Estimates', University Press, 2006
3. D.N.Banerjee,'Principles and Practices of Valuation',V Edition,EasternLawHouse, 1998


**REFERENCES:**


1. Hand Book of Consolidated Data – 8/2000, Vol.1,TNPWD
2. Tamil Nadu Transparencies in Tenders Act, 1998
3. Arbitration and Conciliation Act, 1996
4. Standard Bid Evaluation Form, Procurement of Good or Works, The World Bank, April 1996
5. Standard Data Book for Analysis and Rates, IRC, New Delhi.

| 21CE1702 | IRRIGATION ENGINEERING | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**OBJECTIVES:**

- The student is exposed to different phases in irrigation practices and Planning and management of irrigation. Further they will be imparted required knowledge on Irrigation storage and distribution canal system and Irrigation management.

**UNIT I CROP WATER REQUIREMENT 9**

Need and classification of irrigation- historical development and merits and demerits of irrigation-types of crops-crop season-duty, delta and base period- consumptive use of crops- estimation of Evapotranspiration using experimental and theoretical methods

**UNIT II IRRIGATION METHODS 9**Tank irrigation – Well irrigation – Irrigation methods: Surface and Sub-Surface and Micro Irrigation – design of drip and sprinkler irrigation – ridge and furrow irrigation-Irrigation scheduling – Water distribution system-Irrigation efficiencies.

**UNIT III DIVERSION AND IMPOUNDING STRUCTURES 9**

Types of Impounding structures - Gravity dam – Forces on a dam -Design of Gravity dams; Earth dams, Arch dams- Diversion Head works - Weirs and Barrages-

**UNIT IV CANAL IRRIGATION 9**

Canal regulations – direct sluice - Canal drop – Cross drainage works-Canal outlets – Design of prismatic canal-canal alignments-Canal lining - Kennedy's and Lacey's Regime theory-Design of unlined canal

**UNIT V WATER MANAGEMENT IN IRRIGATION 9**

Modernization techniques- Rehabilitation – Optimization of water use-Minimizing water losses- On form development works-Participatory irrigation management- Water resources associations- Changing paradigms in water management-Performance evaluation-Economic aspects of irrigation

**TOTAL :45 PERIODS**

**OUT COMES:**

Students will be able to

1. Have knowledge and skills on crop water requirements.
2. Understand the methods and management of irrigation.
3. Gain knowledge on types of Impounding structures
4. Understand methods of irrigation including canal irrigation.
5. Get knowledge on water management on optimization of water use.

**TEXTBOOKS:**


1. Michael A.M., Irrigation Theory and Practice, 2nd Edition, Vikas Publishing House Pvt. Ltd., Noida, Up, 2008
2. Dilip Kumar Majumdar, "Irrigation Water Management", Prentice-Hall of India, New Delhi, 2008.
3. Asawa, G.L., "Irrigation Engineering", NewAge International Publishers, New Delhi, 2000.
4. Basak, N.N, "Irrigation Engineering", Tata McGraw Hill Publishing Co. New Delhi,1999
5. Punmia B.C., et. al; Irrigation and water power Engineering, Laxmi Publications, 16th Edition, New Delhi, 2009
6. Garg S. K., "Irrigation Engineering and Hydraulic structures", Khanna Publishers, 23rd Revised Edition, New Delhi, 2009


**REFERENCES:**


1. Duggal, K.N. and Soni, J.P., "Elements of Water Resources Engineering", New Age International Publishers, 2005
2. Linsley R.K. and Franzini J.B, "Water Resources Engineering", McGraw-Hill Inc, 2000
3. Chaturvedi M.C., "Water Resources Systems Planning and Management", Tata McGraw-Hill Inc., New Delhi, 1997.
4. Sharma R.K.. "Irrigation Engineering", S.Chand & Co. 2007.

| 21CE1711 | IRRIGATION AND ENVIRONMENTAL ENGINEERING DRAWING | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 4 | 2 |

**OBJECTIVES:**

- At the end of the semester, the student shall conceive, design and draw the irrigation and environmental engineering structures in detail showing the plan, elevation and Sections.

**PART A: IRRIGATION ENGINEERING**

**1. TANK COMPONENTS** **9**

Fundamentals of design - Tank surplus weir – Tank sluice with tower head - Drawings showing foundation details, plan and elevation

**2. IMPOUNDING STRUCTURES** **6**

Design principles - Earth dam – Profile of Gravity Dam

**3. CROSS DRAINAGE WORKS** **6**

General design principles - Aqueducts – Syphon aqueduct (Type III) – Canal drop (Notch Type) – Drawing showing plan, elevation and foundation details.

**4. CANAL REGULATION STRUCTURES** **9**

General Principles - Direct Sluice - Canal regulator - Drawing showing detailed plan, elevation and foundation details.

**PART B: ENVIRONMENTAL ENGINEERING**

**1. WATER SUPPLY AND TREATMENT** **15**

Design and Drawing of flash mixer, Clarifloculator– Rapid sand filter – Service reservoirs –Pumping station – House service connection for water supply and drainage.

**4. SEWAGE TREATMENT & DISPOSAL** **15**

Design and Drawing of screen chamber - Grit channel - Primary clarifier - Activated sludge process – Aeration tank – Trickling filter – Sludge digester – Sludge drying beds – Waste stabilisation ponds - Septic tanks and disposal arrangements.

**TOTAL: 60 PERIODS**

**OUTCOMES:**

- The students after completing this course will be able to design and draw various units of municipal water treatment plants and sewage treatment plants.

**TEXTBOOKS:**


1. Satya Narayana Murthy Challa, “Water Resources Engineering: Principles and Practice”, New Age International Publishers, New Delhi, 2002.
2. Garg, S.K., “Irrigation Engineering and Design of Structures”, New Age International Publishers, New Delhi, 1997.
3. Manual on Water Supply and Treatment, CPHEEO, Government of India, New Delhi, 1999.
4. Manual on “Sewerage and Sewage Treatment Systems- Part A, B and C” CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 2013.


**REFERENCES:**


1. Mohanakrishnan. A, “A few Novel and Interesting Innovative Irrigation Structures: Conceived, Designed and Executed in the Plan Projects in Tamil Nadu”, Publ. No. 44 and Water Resources Development & Management Publ.No.43, IMTI Thuvakudy, Trichy,2011.
2. Raghunath, H.M. “Irrigation Engineering”, Wiley India Pvt. Ltd., New Delhi, 2011.
3. Sharma R.K., “Irrigation Engineering and Hydraulic Structures”, Oxford and IBH Publishing Co.,

New Delhi, 2002.
4. Peary, H.S., ROWE, D.R., Tchobanoglous, G., “Environmental Engineering”, McGraw- HillBook Co., New Delhi, 1995.
5. Metcalf and Eddy, “Wastewater Engineering, Treatment and Reuse”, Tata McGraw-Hill,New Delhi, 2010.
6. Qasim,S.R., Motley, E.M and Zhu.G. "Water works Engineering – Planning, Design and Operation", Prentice Hall, New Delhi, 2009.
7. Qasim, S. R. "Wastewater Treatment Plants, Planning, Design & Operation", CRC Press,New York, 2010

| 21CE1712 | DESIGN PROJECT<br><br>(Activity Based - Subject Related) | L | T | P | C |
|---|---|---|---|---|---|
| | | 0 | 0 | 4 | 2 |

**OBJECTIVE:**

- To use the knowledge acquired in Civil Engineering to do a mini project, which allows the students to come up with designs, fabrication or algorithms and programs expressing their ideas in a novel way.

**TOTAL: 60 PERIODS**

**STRATEGY**

To identify a topic of interest in consultation with Faculty/Supervisor. Review the literature and gather information pertaining to the chosen topic. State the objectives and develop a methodology to achieve the objectives. Carryout the design / fabrication or develop computer code. Demonstrate the novelty of the project through the results and outputs.

## SYLLABUS OF OPEN ELECTIVE COURSES

| 21CE1001 | ENERGY CONVERSION AND MANAGEMENT | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

OBJECTIVES:

- To impart knowledge on the principle of Energy Conversion and Management ,Energy and environment, air pollution, climate change
- To provide details of Energy Conservation, Energy Management & Audit.

UNIT I **ENERGY SCENARIO AND ENERGY CONSERVATION ACT 2001** **9**

Classification of Energy, Indian energy scenario, Sectorial energy consumption (domestic, industrial and other sectors), energy needs of growing economy, energy intensity, long term energy scenario, energy pricing, energy security, energy conservation and its importance, energy strategy for the future. Energy conservation Act 2001 and its features, notifications under the Act, Schemes of Bureau of Energy Efficiency (BEE) including Designated consumers, State Designated Agencies, Electricity Act 2003, Integrated energy policy, National action plan on climate change, ECBC code for Building Construction

UNIT II **FINANCIAL MANAGEMENT, ENERGY MONITORING AND TARGETING** **9**

Investment-need, financial analysis techniques simple payback period, return on investment, net present value, internal rate of return, cash flows, risk and sensitivity analysis; financing options, energy performance contracts and role of Energy Service Companies (ESCOs).Defining monitoring & targeting, elements of monitoring & targeting, data and information-analysis, techniques – energy consumption, production, cumulative sum of differences (CUSUM). Energy Management Information Systems (EMIS)

UNIT III **ENERGY MANAGEMENT & AUDIT** **9**

Definition, energy audit, need, 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 and energy substitution, energy audit instruments and metering.

UNIT IV **ENERGY EFFICIENCY IN THERMAL UTILITIES AND SYSTEMS** **9**

**Boilers:** Types, combustion in boilers, performances evaluation, analysis of losses, feed water treatment, blow down, energy conservation opportunities. Boiler efficiency calculation, evaporation ratio and efficiency for coal, oil and gas. Soot blowing and soot deposit reduction, reasons for boiler tube failures, start up, shut down and preservation.

**Steam System:** Properties of steam, assessment of steam distribution losses, steam leakages, steam trapping, condensate and flash steam recovery system, identifying opportunities for energy savings. Steam utilization, Performance assessment of steam system, thermo- compressor, steam pipe insulation, condensate pumping, steam dryers.

**Waste Heat Recovery:** Classification, advantages and applications, commercially viable waste heat recovery devices, saving potential.

UNIT V **ENERGY AND ENVIRONMENT, AIR POLLUTION, CLIMATE CHANGE** **9**

United Nations Framework Convention on Climate Change (UNFCC), sustainable development, Kyoto Protocol, Conference of Parties (COP), Clean Development Mechanism (CDM), CDM Procedures case of CDM – Bachat Lamp Yojna and industry; Prototype Carbon Fund (PCF).

TOTAL : 45 PERIODS

**OUTCOMES:**

At the End of the Course, Learners will be able to:

1. To summarized the energy conservation scenario, energy and environment, air pollution, climate change, and various acts and policy for the energy conservation.
2. To infer the concept of financial management, energy monitoring and targeting.
3. To apply the knowledge of energy audit for the energy management and operation of energy audit instruments.
4. To analyze the energy saving area and improvement in efficiency of various thermal utilities and systems.
5. To evaluate the net present worth in financial management and performance assessment of various thermal utilities and systems.

**Reference Books:**


1. Energy Conservation Guidebook, Dale R Patrick, Stephen W Fardo, 2nd Edition, CRC Press
2. Handbook of Energy Audits, Albert Thumann, 6th Edition, The Fairmont Press.
3. Bureau of Energy Efficiency Reference book: No.1, 2, 3, 4.
4. Energy Management Handbook, W.C. Turner, John Wiley and Sons, A Wiley Interscience publication.
5. Carbon Capture and Sequestration: Integrating Technology, Monitoring, and Regulationedited byE J Wilson and D Gerard, Blackwell Publishing.

| 21CE1002 | ENVIRONMENT AND AGRICULTURE | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

OBJECTIVES:

- To emphasize on the importance of environment and agriculture on changing global scenario and the emerging issues connected to it.

UNIT I **ENVIRONMENTAL CONCERNS** **9**

Environmental basis for agriculture and food – Land use and landscape changes – Water quality issues – Changing social structure and economic focus – Globalization and its impacts – Agro ecosystems.

UNIT II **ENVIRONMENTAL IMPACTS** **9**

Irrigation development and watersheds – mechanized agriculture and soil cover impacts – Erosion and problems of deposition in irrigation systems – Agricultural drainage and downstream impacts –Agriculture versus urban impacts.

UNIT III **CLIMATE CHANGE** **9**

Global warming and changing environment – Ecosystem changes – Changing blue-green-grey water cycles – Water scarcity and water shortages – Desertification.

UNIT IV **ECOLOGICAL DIVERSITY AND AGRICULTURE** **9**

Ecological diversity, wild life and agriculture – GM crops and their impacts on the environment – Insets and agriculture – Pollination crisis – Ecological farming principles – Forest fragmentation and agriculture – Agricultural biotechnology concerns.

UNIT V **EMERGING ISSUES** **12**

Global environmental governance – alternate culture systems – Mega farms and vertical farms – Virtual water trade and its impacts on local environment – Agricultural environment policies and its impacts – Sustainable agriculture.

TOTAL : 45 PERIODS

**OUTCOMES:**

At the End of the Course, will be able to:

1. Students will appreciate the role of environment in the current practice of agriculture and concerns of sustainability, especially in the context of climate change and emerging global issues.
2. Ecological context of agriculture and its concerns will be understood

**TEXT BOOKS:**


1. M.Lakshmi Narasaiah, Environment and Agriculture, Discovery Pub. House, 2006.
2. Arvind Kumar, Environment and Agriculture, ABH Publications, New Delhi, 2005.


**Reference Books:**


1. T.C. Byerly, Environment and Agriculture, United States. Dept. of Agriculture. Economic Research Service, 2006.
2. Robert D. Havener, Steven A. Breth, Environment and agriculture: rethinking development issues for the 21st century : proceedings of a symposium, Winrock International Institute for Agricultural Development, 1994
3. Environment and agriculture: environmental problems affecting agriculture in the Asia and Pacific region; World Food Day Symposium, Bangkok, Thailand. 1989

| 21ME1916 | NANOTECHNOLOGY | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

OBJECTIVES:

- To provide details of perspective of nano-technology applications of nanotechnology in various engineering applications

UNIT I **INTRODUCTION TO NANOTECHNOLOGY** **9**

Basic Structure of Nano particles- Kinetics in Nano structured Materials- Zero dimensional, size, and shape of nano particles - one-dimensional and two dimensional nanostructures - clusters of metals and semiconductors, bio nano-particles.

UNIT II **FABRICATION AND CHARACTERIZATION OF NANOMATERIALS** **9**

Types of Nano materials (Quantum dots, Nano particles, Nano crystals, Dendrimers, Bucky balls, Nano tubes) – G as, liquid, and solid–phase synthesis of nano-materials - Lithography techniques (Photolithography, Dip-pen and Electron beam lithography) - Thin film deposition – Electro spinning - Bio-synthesis of nano materials.

UNIT III **PROPERTIES AND MEASUREMENT OF NANOMATERIALS** **9**

Optical Properties: Absorption, Fluorescence, and Resonance - Methods for the measurement of nanomaterials - Microscopy measurements: SEM, TEM, AFM and STM - Confocal and TIRF imaging.

UNIT IV **NANO STRUCTURES** **9**

Carbon Nanotubes - Fullerenes - Nanowires - Quantum Dots - Applications of nanostructures - Reinforcement in Ceramics - Drug delivery - Giant magneto-resistance - Cells response to Nanostructures.

UNIT V **APPLICATIONS OF NANOTECHNOLOGY** **9**

Nano electronics - Nano sensors - Nanotechnology in Diagnostics applications - Environmental and Agricultural Applications of nanotechnology - Nano technology for energy systems - Nanotechnology and AI integration

TOTAL : 45 PERIODS

**Course outcomes**

1. Understand the overall perspective of nano-technology by assimilating the various parameters including kinetics, dimensions, and clusters
2. Realize the characterization as well as fabrication aspects of nano-materials and the various methodologies
3. Analyze the optical properties and the nano-material measurement.
4. Assimilate nano-structures and their myriad applications in various engineering realms
5. Recognize the numerous applications of nanotechnology in various engineering applications

**TEXT BOOKS**

1. Springer Handbook of Nanotechnology by Bharat Bhushan 2004.
2. Encyclopedia of Nanotechnology - Hari Singh Nalwa 2004.

**REFERENCE BOOKS**

1. Nanomaterials, Nanotechnologies and Design: an Introduction to Engineers and Architects,D. Michael Ashby, Paulo Ferreira, Daniel L. Schodek, Butterworth-Heinemann, 2009.

2. Handbook of Nanophase and Nanostructured Materials (in four volumes), Eds: Z.L. Wang, Y. Liu, Z. Zhang, Kluwer Academic/Plenum Publishers, 2003.
3. Handbook of Nanoceramics and their Based Nanodevices (Vol. 2) Edited by Tseung-Yuen Tseng and Hari Singh Nalwa, American Scientific Publishers.

**WEB REFERENCES**

- https://physicsworld.com/c/materials/nanomaterials/
- https://www.sciencedirect.com/journal/nano-today
- https://www.rsc.org/journals-books-databases/about-journals/nanoscale-horizons/
- https://www.sciencedaily.com/news/matter_energy/nanotechnology/
- https://www.nanowerk.com/
- https://iopscience.iop.org/article/10.1088/0957-4484/24/45/452002

**ONLINE COURSES / RESOURCES:**

- https://www.udemy.com/topic/nanotechnology/
- https://www.edx.org/learn/nanotechnology
- https://www.coursera.org/courses?query=nanotechnology
- https://onlinecourses.nptel.ac.in/noc19_mm21/preview
- https://coursesity.com/free-tutorials-learn/nanotechnology

| 21ME1009 | PRODUCTION TECHNOLOGY | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

OBJECTIVES:

- To impart basic knowledge and understanding about the primary manufacturing processes such as casting, joining, forming and powder metallurgy.
- To gain knowledge in recent trends in process and manufacturing industry.
- To categorize the metal cutting process for manufacturing of a product.

UNIT I **INTRODUCTION** **9**

Introduction. Manufacturing cycle. Manufacturing processes and their selection. Engineering materials and their selection. Powder metallurgy processing: Production of metal powders, compaction and sintering processes.

UNIT II **CASTING AND JOINING PROCESS** **9**

Casting: Patterns, gating system design, riser design, product design, defects, inspection techniques. Other casting processes: investment casting, die casting, centrifugal casting and continuous casting. Basic design considerations in casting.

Joining processes: Fusion welding processes, heat affected zone, testing of welded joints, solid state welding processes, brazing and soldering. Basic design considerations in welding. Process selection. Adhesive bonding. Mechanical fastening processes.

UNIT III **METAL FORMING AND HEAT TREATMENT PROCESS** **9**

Metal forming: Plastic deformation, hot and cold working. Forming operations-rolling, extrusion, drawing processes, sheet metal operations, load estimations for homogeneous deformation. Sheet metal die design. High velocity forming processes.

Heat treatment processes. Processing of plastics: Extrusion, injection moulding, blow moulding, rational moulding, thermo-forming and compression moulding. Basic design considerations, rapid prototyping, stereo lithography technique.

UNIT IV **METAL CUTTING AND MACHINE TOOLS** **9**

Metal cutting: Tool .materials, tool geometry and nomenclature in ASA, ORS and NRS, cutting fluids, single and multipoint cutting operations, production of gears and screw threads, grinding and finishing processes, specification of grinding wheels. Machine tools: Primary and secondary drives, guideway and slideways, structure. Introduction to NC, CNC and DNC machining.

UNIT V **NEW MACHINING METHODS** **9**

Process capabilities and limitations of AJM, USM, WJM, ECM, ECG, EDM, EBM and LBM processes.

TOTAL: 45 PERIODS

**OUTCOMES:**

At the End of the Course, Learners will be able to:

1. Capability of selecting suitable manufacturing processes to manufacture the products optimally.
2. Recommend the appropriate design of gating systems, forming processes, welding process and NDT technique.
3. Develop simplified manufacturing processes with the aim of reduction of cost and manpower.
4. Identify/control the appropriate process parameters, and possible defects of manufacturing processes so as to remove them.
5. Identify the proper NTM method for given component.

**TEXT BOOKS:**

1. Production Technology, HMT., 2002 .
2. R.K.Rajput, Paul Keller"A Textbook of Manufacturing Technology (Manufacturing Processes)", Laxmi Publications., 2012.
3. P.C.Sharma., "Production Engineering", S.Chand & Co., 2002.
4. Rao, P.N., Manufacturing Technology, Volume 2, McGraw-Hill Education, New Delhi.
5. Groover, M. P., "Fundamentals of Modern Manufacturing", John Wiley and Sons Inc.,2002.

**Reference Books:**

1. Lindberg R.A, Processes and Materials of Manufacture, Prentice Hall of India (P) Ltd.,1996.
2. DeGarmo, E. P, Black, J. T., Kohser, R. A. "Materials and Processes in Manufacturing", Prentice Hall of India Pvt. Limited, 1997.
3. Khanna, O.P., and Lal, M., A Text Book of Production Technology, Vol I & II, Dhanpat Rai & Sons, 1992.
4. Jain R K ., "Production Technology: Manufacturing Processes, Technology and Automation" Khanna Publication 2004.

**Web references:**

- https://soaneemrana.org/onewebmedia/Manufacturing%20Processes%20By%20H.N.%20Gupta.pdf
- https://www.cet.edu.in/noticefiles/257_Basic%20Manufacturing%20Processes-ilovepdf-compressed.pdf
- https://www.teachmint.com/tfile/studymaterial/class-1st/productiontechnology/productiontech-1pdf/75978f9e-7689-4b5f-9fbd-c30910ecb82b

**Online Courses / Resources:**

- https://www.coursea.org/courses
- https://www.udemy.com/topic/manufacturing/
- https://www.classcentral.com/subject/manufacturing
- https://onlinecourses.nptel.ac.in/noc22_me99/preview

| 21ME1917 | RENEWABLE ENERGY RESOURCES | L | T | P | C |
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OBJECTIVES:

- To get exposure on solar radiation and its environmental impact to power.
- To know about the various collectors used for storing solar energy.
- To know about the various applications in solar energy.
- To learn about the wind energy and biomass and its economic aspects.
- To know about geothermal energy with other energy sources.

UNIT I **PRINCIPLES OF SOLAR RADIATION** **9**

Role and potential of new and renewable source, the solar energy option, Environmental impact of solar power, physics of the sun, the solar constant, extraterrestrial and terrestrial solar radiation, solar radiation on titled surface, instruments for measuring solar radiation and sun shine, solar radiation data.

UNIT II **SOLAR ENERGY COLLECTION** **9**

Laws of Wear - Types of Wear mechanism – wear debris analysis - Theoretical wear models - Wear of metals and non-metals – International standards in friction and wear measurements

UNIT III **SOLAR ENERGY STORAGE AND APPLICATIONS** **9**

Different methods, Sensible, latent heat and stratified storage, solar ponds. Solar Applications - solar heating/cooling technique, solar distillation and drying, photovoltaic energy conversion

UNIT IV **WIND ENERGY** **9**

Sources and potentials, horizontal and vertical axis windmills, performance characteristics, Betz criteria BIO-MASS: Principles of Bio-Conversion, Anaerobic/aerobic digestion, types of Bio-gas digesters, gas yield, combustion characteristics of bio-gas, utilization for cooking, I.C-Engine operation and economic aspects.

UNIT V **GEOTHERMAL ENERGY** **9**

Introduction – High and low friction materials - Advanced alloys – Super alloys, Titanium alloys, Magnesium alloys, Aluminium alloys, and Nickel based alloys – Ceramics – Polymers – Biomaterials – Bio Tribology - Nano Tribology

TOTAL : 45 PERIODS

**OUTCOMES:**

At the End of the Course, Learners will be able to:

1. Understand the renewable source, the solar energy option, Environmental impact of solar power physics of the sun the solar constant.
2. Apply the knowledge of Flat plate and concentrating collectors, classification of concentrating collectors.
3. Determine Sensible, latent heat and stratified storage, solar ponds photovoltaic energy conversion.
4. Determine horizontal and vertical axis windmills, performance characteristics combustion characteristics of bio-gas.
5. Methods of harnessing the energy, potential in India Principles utilization, setting of OTEC plants.

**TEXT BOOKS:**


1. Rai G.D. , “Non-Conventional Energy Sources”, Khanna Publishers, 2011.
2. Ramesh R & Kumar K.U , “Renewable Energy Technologies”,Narosa Publishing House, 2004.

**Reference Books:**


1. Tiwari and Ghosal, "Renewable energy resources", Narosa Publishing House, 2007.
2. Twidell&Wier, "Renewable Energy Resources", CRC Press (Taylor & Francis), 2011.
3. Mittal K M, "Non-Conventional Energy Systems", Wheeler Publishing Co. Ltd, New Delhi, 2003.
4. Kothari D.P, Singhal ., K.C., "Renewable energy sources and emerging technologies", P.H.I, New Delhi.


**Web references:**

- https://onlinecourses.nptel.ac.in/noc21_ch11/preview
- https://archive.nptel.ac.in/courses/103/103/103103206/

**Online Courses / Resources:**

- https://www.pdfdrive.com/non-conventional-energy-systems-nptel-e17376903.html.
- https://www.iitr.ac.in/wfw/web_ua_water_for_welfare/education/proceeding_of_shortterm_training/diploma/hydropower_dev_engg_elec/lecture_notes/LECTURE_ON_RENEWABLE_ENERGY_SOURCES.pdf.
- http://digimat.in/nptel/courses/video/103103206/L01.html..
- https://onlinecourses.nptel.ac.in/noc20_ge06/preview.

| 21EC1009 | SENSORS AND TRANSDUCERS | L | T | P | C |
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OBJECTIVES:

- To understand the structural and functional principles of sensors and transducers used for various physical and nonelectric quantities.
- To explain the principles of operation of the sensor parameters
- To understand the knowledge about the implementation of sensors and transducers into a control system structure.

UNIT I **INTRODUCTION** **9**

Basic method of measurement, generalized scheme for measurement systems, units and standards, errors, classification of errors, error analysis, statistical methods, sensor, transducer , classification of transducers, basic requirement of transducers.

UNIT II **CHARACTERISTICS OF TRANSDUCERS** **9**

Static characteristics, dynamic characteristics, mathematical model of transducer, zero, first order and second order transducers – response to step, ramp and sinusoidal inputs.

UNIT III **RESISTIVE, INDUCTIVE AND CAPACITANCE TRANSDUCERS** **9**

Potentiometer, Strain gauge, LVDT, variable reluctance transducers, Proximity transducers, capacitive transducer, Capacitor microphone, capacitive thickness Transducers, capacitive strain transducers, hall effect transducer, fiber optic transducer and its application.

UNIT IV **DATA ACQUISITION** **9**

Types of transducer, signals, signal conditioning, DAQ hardware, analog inputs and outputs, DAQ software architecture, selection and configuration data acquisition device, components of computer based measurement system

UNIT V **SENSORS** **9**

Introduction to sensors, types of sensor, smart sensors, fiber optic sensors, MEMS, nano sensors, Ultrasonic Sensors, Thin Film Sensors, Liquid Level Sensors, typical application of sensors

TOTAL : 45 PERIODS

**OUTCOMES:**

At the End of the Course, Learners will be able to:

1. Classify and describe various transducers which are used for measuring various parameter like displacement, temperature etc.
2. Understand the static and dynamics characteristics of transducers
3. Identify the type of transducers used for various application
4. Understand the virtual instrumentation for various data acquisition
5. Understand the types sensor used for various applications

**TEXT BOOKS:**

1. Revised Edition of 'English for Engineers and Technologists' Volume 1 published by Orient Black Swan Limited 2019.

**Reference Books:**

1. Doebelin. E.A, "*Measurement Systems – Applications and Design*", Tata McGraw Hill, New York, 2000.
2. Patranabis. D, "*Sensors and Transducers*", Prentice Hall of India, 1999.
3. John. P, Bentley, "*Principles of Measurement Systems*", III Edition, Pearson Education, 2000.
4. Doebelin. E.A, "*Measurement Systems – Applications and Design*", Tata McGraw Hill, New York, 2000.

| 21CS1002 | SOFTWARE ENGINEERING | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

OBJECTIVES:

- To understand the phases in a software project
  To understand fundamental concepts of requirements engineering and AnalysisModeling.
- To understand the various software design methodologies, software testing,software process models
- To learn various and maintenance measures
  To understand the working knowledge of the techniques for estimation, design, testing and quality management of large software development projects

UNIT I **SOFTWARE PROCESS MODELS** **9**

Introduction to Software Engineering, Software Process, Perspective and Specialized Process Models – Waterfall model – Spiral Model – V shaped model – RAD model – Iterative Model– Prototype model. Introduction to Agility : Extreme programming

UNIT II **REQUIREMENTS ANALYSIS AND SPECIFICATION** **9**

Software Requirements: Functional and Non-Functional, User requirements, System requirements, Software Requirements Document – Requirement Engineering Process: Feasibility Studies, Requirements elicitation and analysis, requirements validation, requirements management-Classical analysis: Structured system Analysis.

UNIT III **SOFTWARE DESIGN** **9**

Design process – Design Concepts-Design Model– Design Heuristic – Architectural Design - Architectural styles, Architectural Design, Architectural Mapping using Data Flow- User Interface Design: Interface analysis, Interface Design –Component level Design: Designing Class based components, traditional Components.

UNIT IV **TESTING AND MAINTENANCE** **9**

Software testing fundamentals-Internal and external views of Testing-white box testing - basis path testing-control structure testing-black box testing- Regression Testing – Unit Testing – Integration Testing – Validation Testing – System Testing And Debugging – Software Implementation Techniques: Coding practices-Refactoring-Maintenance and Reengineering-BPR model-Reengineering process model-Reverse and Forward Engineering.

UNIT V **PROJECT MANAGEMENT** **9**

Software Project Management: Estimation – LOC, FP Based Estimation, Make/Buy Decision COCOMO I & II Model – Project Scheduling – Scheduling, Earned Value Analysis Planning Project Plan, Planning Process, RFP Risk Management – Identification, Projection - Risk Management-Risk Identification-RMMM Plan-CASE TOOLS

TOTAL : 45 PERIODS

**OUTCOMES:**

At the End of the Course, Learners will be able to:

1. Decompose the given project in various phases of a lifecycle.
2. Choose appropriate process model depending on the user requirements.
3. Perform various life cycle activities like Analysis, Design, Implementation, Testingand Maintenance.
4. Know various processes used in all the phases of the product.
5. Apply the knowledge, techniques, and skills in the development of a softwareproduct.
6. Estimate the size of the software product.

**TEXT BOOKS:**


1. Roger S. Pressman, Bruce R.Maxim—Software Engineering – A Practitioner'sApproach, Eight Edition, McGraw-Hill International Edition, 2015.
2. IanSommerville, —Software Engineering, 9th Edition, Pearson Education Asia, 2011.


**Reference Books:**


1. Rajib Mall, —Fundamentals of Software Engineering, Third Edition, PHI LearningPrivateLimited,2009.
2. PankajJalote, —Software Engineering, A Precise Approach, Wiley India, 2010.
3. Kelkar S.A., —Software Engineering, Prentice Hall of India Pvt Ltd, 2007.
4. Stephen R.Schach, —Software Engineering, Tata McGraw-Hill PublishingCompany Limited,2007.

http://nptel.ac.in


**Web references:**

- https://ethics.acm.org/code-of-ethics/software-engineering-code/
- https://freecomputerbooks.com/specialSoftwareBooks.html
- https://unimelb.libguides.com/comsci_softeng_infotech

**Online Courses / Resources:**

- https://www.geeksforgeeks.org/software-engineering-introduction-to-software-engineering/
- https://www.w3schools.in/category/software-testing/
- https://www.tutorialspoint.com/software_engineering/index.htm
- https://www.javatpoint.com/software-engineering-tutorial
- https://nptel.ac.in/courses/

| 21ME1907 | NOISE VIBRATION AND HARSHNESS | L | T | P | C |
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OBJECTIVES:

- Understand the various types of vibration with damping and without damping
- Understand the Various types of noise and its measurement and analysis techniques.
- Understand the various sources of noise from automobiles.
- Understand the various noise controlling techniques.
- Understand the various noise from mechanical components and its suppressing techniques.

UNIT I **FUNDAMENTALS OF NOISE, VIBRATION, AND HARSHNESS** **9**

Theory of sound - Predictions and measurement, Sound sources, Sound propagation in the Atmosphere, Sound radiation from structures and their response to sound, Introduction to vibration, free and forced vibration, undamped and damped vibration, Vibration of simple discrete and continuous systems, Torsional vibration, Determination of natural frequencies., Definition of Harshness, Its effect and acceptable degree of Harshness.

UNIT II **DIALOGUE WRITING VIBRATIONS MEASUREMENT TECHNIQUES AND CONTROL** **9**

Vibration measuring Instruments: Vibration pick-up, Types of transducers, Vibrometer for measurement of Frequency of vibrations, Period, Amplitude, Velocity and Acceleration parameters, Vibrations isolation, Different types of vibration absorber.

UNIT III **TRANSPORTATION NOISE AND VIBRATION - SOURCES, PREDICTION, AND CONTROL** **9**

Introduction to Transportation noise and vibration sources, Internal combustion engine noise prediction and control - Diesel, Exhaust and Intake noise and Acoustical design of mufflers, Tire/Road Noise - Generation, Measurement, and Abatement, Aerodynamic sound sources in vehicles - Prediction and Control, Transmission and Gearbox noise and vibration prediction and control, Brake noise prediction and control, Perception of Ride comfort

UNIT IV **INTERIOR TRANSPORTATION NOISE AND VIBRATION SOURCES - PREDICTION AND CONTROL** **9**

Introduction to Interior transportation noise and vibration sources, Automobile, Bus and Truck Interior noise and vibration prediction and control, Noise and Vibration in Off-Road vehicle Interiors - Prediction and control

UNIT V **NOISE AND VIBRATION ANALYSIS EQUIPMENT, SIGNAL PROCESSING, AND MEASURING TECHNIQUES** **9**

General Introduction to noise and vibration measuring equipment, Signal acquisition and processing, Acoustical transducer principles and Types of microphones, Sound level meters, Noise Dosimeters, Analyzers and signal generators, Equipment for data acquisition, Determination of sound power level and emission sound pressure level, Sound intensity measurements, Noise and vibration data analysis. Calibration of measurement microphones, Calibration of shock and vibration transducers, Metrology and traceability of vibration and shock measurements.

TOTAL : 45 PERIODS

**OUTCOMES:**

At the End of the Course, Learners will be able to:

1. Discuss the basic fundamentals of noise and vibrations.
2. Classify and discuss the various techniques to measure and control the automotive vibrations.

3. Describe the effects of transportation noise and its control techniques.
4. Outline the effects of interior transportation noise and its control techniques related to automobile.
5. Describe the measurement techniques of noise, vibration pertaining to an automobile

**TEXT BOOKS:**


1. David A.Bies and Colin H.Hansen, "Engineering Noise Control: Theory and Practice", Spon Press, London, 2009.
2. Mathew Harrison, "Vehicle refinement Controlling Noise and vibration in road vehicles", SAE International, Elsevier Butterworth-Heinemann, 2008.
3. Xu Wang, "Vehicle Noise and Vibration Refinement", Woodhead Publishing Limited,2010.


**Reference Books:**


1. Allan G. Piersol, Thomas L. Paez, Harris, "Shock and Vibration Handbook", McGraw-Hill, New Delhi, 2010.
2. Clarence W. de Silva, "Vibration Monitoring, Testing, and Instrumentation", CRC Press, 2007.
3. Colin H Hansen, "Understanding Active Noise Cancellation", Spon Press, London 2003.
4. Kewal Pujara, "Vibrations and Noise for Engineer"s, Dhanpat Rai & Sons, 1992.
5. Matthew Harrison, "Vehicle Refinement: Controlling Noise and Vibration in Road Vehicles", Elsevier Butterworth-Heinemann, Burlington, 2004.


**Web references:**

- https://link.springer.com/chapter/10.1007/978-94-007-0516-6_5
- https://www.researchgate.net/publication/277705941_Drivetrain_Noise_Vibration_and_Harshness

**Online Courses / Resources:**

- https://umdearborn.edu/cecs/graduate-programs/certificates/automotive-noise-vibration-harshness-nvh
- https://onlinecourses.nptel.ac.in/noc19_me72/preview
- https://www.udemy.com/course/automotive-engineering-nvh-essentials/

| 21CE1003 | AGRICULTURAL FINANCE, BANKING AND CO-OPERATION | L | T | P | C |
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OBJECTIVES:

- To make the students aware about the agricultural Finance, Banking and Cooperation.
- To acquaint the students with the basic concepts, principles and functions of management.
- To understand the process of finance banking and cooperation.

UNIT I **AGRICULTURAL FINANCE - NATURE AND SCOPE** **9**

Agricultural Finance: Definition, Importance, Nature and Scope - Agricultural Credit: Meaning, Definition, Need and Classification - Sources of credit - Role of institutional and non - Institutional agencies: Advantages and Disadvantages - Rural indebtedness: consequences of rural indebtedness - History and Development of rural credit in India.

UNIT II **FARM FINANCIAL ANALYSIS** **9**

Principles of Credit - 5C's, 5R's and & 7P's of Credit - Project Cycle and Management - Preparation of bankable projects / Farm credit proposals - Feasibility - Time value of money: Compounding and Discounting - Appraisal of farm credit proposals - Undiscounted and discountedmeasures - Repayment plans - Farm Financial Statements: Balance Sheet, Income Statement andCash Flow statement - Financial Ratio Analysis.

UNIT III **FINANCIAL INSTITUTIONS** **9**

Institutional Lending Agencies - Commercial banks: Nationalization, Agricultural DevelopmentBranches - Area Approach - Priority Sector Lending - Regional Rural Banks, Lead bank, Scale of finance - Higher financial institutions: RBI, NABARD, AFC, ADB, World Bank and Deposit Insurance and Credit Guarantee Corporation of India - Microfinance and its role in poverty alleviation - Self-Help Groups - Non -Governmental Organizations - Rural credit policies followed by State and Central Government - Subsidized farm credit, Differential Interest Rate (DIR), Kisan Credit Card (KCC) Scheme - Relief Measures and Loan Waiver Scheme and Know Your Customer (KYC).

UNIT IV **CO-OPERATION** **9**

Co-operation: Philosophy and Principles - History of Indian Cooperative Credit Movement: Pre andPost-Independence periods and Cooperation in different plan periods - Cooperative credit institutions: Two tier and three tier structure, Functions: provision of short term and long term credit, Strength and weakness of cooperative credit system, Policies for revitalizing cooperative credit: Salient features of Vaithiyananthan Committee Report on revival of rural cooperative credit institutions, Reorganisation of Cooperative credit structure in Andhra Pradesh and single window system and successful cooperative credit systems in Gujarat, Maharashtra, Punjab etc, - Special cooperatives: LAMPS and FSS: Objectives, role and functions - National Cooperative Development Corporation (NCDC) and National Federation of State Cooperative Banks Ltd.,(NAFSCOB) - Objectives and Functions.

UNIT V **BANKING AND INSURANCE** **9**

Negotiable Instruments: Meaning, Importance and Types - Central Bank: RBI - functions - credit control - objectives and methods: CRR, SLR and Repo rate - Credit rationing - Dear money and cheap money - Financial inclusion and Exclusion: Credit widening and credit deepening monetary policies. Credit gap: Factors influencing credit gap - Non - Banking Financial Institutions (NBFI) - Assessment of crop losses, Determination of compensation -

Crop insurance: Schemes, Coverage, Advantages and Limitations in implementation - Estimation of crop yields - Livestock, insurance schemes - Agricultural Insurance Company of India Ltd (AIC): Objectives and functions.

TOTAL : 45 PERIODS

**OUTCOMES:**

At the End of the Course, Learners will be able to:

1. Be familiar with agricultural finance, Banking, cooperation and basic concepts, principlesand functions of management.

**Reference Books:**


1. Muniraj, R., 1987, Farm Finance for Development, Oxford & IBH, New Delhi
2. Subba Reddy. S and P.Raghu Ram 2011, Agricultural Finance and Management, Oxford &IBH, New Delhi.
3. Lee W.F., M.D. Boehlje A.G., Nelson and W.G. Murray, 1998, Agricultural Finance, KalyaniPublishers, New Delhi.
4. Mammoria, C.B., and R.D. Saxena 1973, Cooperation in India, Kitab Mahal, Allahabad.

| 21CE1004 | GLOBAL CLIMATE CHANGE | L | T | P | C |
|---|---|---|---|---|---|
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OBJECTIVES:

- To understand the basics of weather and climate
- To have an insight on Atmospheric dynamics and transport of heat
- To develop simple climate models and evaluate climate changes using models

UNIT I **BASICS OF WEATHER AND CLIMATE** **9**

Shallow film of Air– stratified & disturbed atmosphere – law – atmosphere Engine. Observation of parameters: Temperature – Humidity – Wind - Pressure – precipitation-surface – networks. Constitution of atmosphere: well stirred atmosphere – process around turbopause – in dry air – ozone – carbon Dioxide – Sulphur Dioxide– Aerosol - water. Evolution of Atmosphere. State of atmosphere: Air temperature – pressure – hydrostatic – Chemistry – Distribution – circulation

UNIT II **ATMOSPHERIC DYNAMICS** **9**

Atmosphere dynamics: law – isobaric heating and cooling – adiabatic lapse rates – equation of motion - solving and forecasting. Forces – Relative and absolute acceleration – Earth's rotation *coriolis* on sphere – full equation of motion – Geostrophy;- Thermal winds –departures – small-scale motion. Radiation, convection and advections: sun & solar radiation – energy balance – terrestrial radiation and the atmosphere – Green house effect- Global warming - Global budget – radiative fluxes - heat transport. Atmosphere and ocean systems convecting & advecting heat.

UNIT III **GLOBAL CLIMATE** **9**

Components and phenomena in the climate system: Time and space scales – interaction and parameterization problem. Gradients of Radiative forcing and energy transports by atmosphere and ocean – atmospheric circulation – latitude structure of the circulation - latitude – longitude dependence of climate features. Ocean circulation: latitude – longitude dependence of climate features – ocean vertical structure – ocean *thermohaline* circulation – land surface processes – carbon cycle.

UNIT IV **CLIMATE SYSTEM PROCESSES** **9**

Conservation of motion: Force – *coriolis* - pressure gradient- velocity equations – Application – geotropic wind – pressure co-ordinates. Equation of State – atmosphere – ocean. Application: thermal circulation – sea level rise. Temperature equation: Ocean – air – Application – decay of sea surface temperature. Continuity equation: ocean – atmosphere. Application: coastal upwelling – equatorial upwelling – conservation of warm water mass. Moisture and salinity equation: conservation of mass – moisture. Source & sinks – latent heat. Moist processes – saturation – convection – Wave processes in atmosphere and ocean.

UNIT V **CLIMATE CHANGE MODELS** **9**

United Nations Framework Convention on Climate Change (UNFCC), sustainable development, Kyoto Protocol, Conference of Parties (COP), Clean Development Mechanism (CDM), CDM Procedures case of CDM – Bachat Lamp Yojna and industry; Prototype Carbon Fund (PCF).

TOTAL : 45 PERIODS

**OUTCOMES:**

At the End of the Course, Learners will be able to:

1. The concepts of weather and climate
2. The principles of Atmospheric dynamics and transport of heat and air mass
3. The develop simple climate models and to predict climate change

**Text Books:**


1. Fundamentals of weather and climate (2nd Edition) Robin Moilveen (2010), OxfordUniversity Press
2. Climate change and climate modeling, J. David Neelin (2011) Cambridge University press.

| 21CE1005 | FUNDAMENTALS OF PLANETARY REMOTE SENSING | L | T | P | C |
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| | | 3 | 0 | 0 | 3 |

OBJECTIVES:

- To provide an insight to the basics of planetary Remote Sensing
- To demonstrate how the Remote Sensing technique is applied to explore the surfacecharacteristics of the planets and its environ.

UNIT I **PLANETARY SCIENCE** **9**

History and inventory of solar system – planet-definition –properties – Formation of solar system. Planetary Atmospheres: composition - thermal structure – clouds – meteorology – photo chemistry– Eddy Diffusion. Surfaces and Interiors: Mineralogy and Petrology – Planetary interiors – surface morphology. Terrestrial planets and the Moon: The moon & Mercury – surface – Atmosphere – Interior – Magnetic Field.

UNIT II **SATELLITE ORBIT** **9**

Equation of 2 body motion: Energy, orbits and energy – Circular Orbits-EOS Terra-Geosynchronous satellite orbit- orbital elements. Launching Satellites and space probes – Retrograde orbits-Inter planetary Transfer – Hohmann Transfer – Gravity Assist-Cassini-Messenger. Breaking into orbit or landing- Retro Rockets-Aerobraking- Parachutes- Impact.

UNIT III **PROPERTIES OF EMR** **9**

Definition of Remote Sensing – Electro Magnetic Radiation: Electromagnetic Spectrum-Development of EM theory – White Light – Excited hydrogen gas – Quantum physics – Definition. EM Radiation: Properties – Radiant energy – Sun's luminosity calculation. Other Energy: Black body radiation – Plank curve of black body. Properties of EMR: Kinetic energy – Polarization, lawsof Max Plank, Wien's and Stephen Boltzmann

UNIT IV **RADIOMETRY AND SCATTEROMETRY** **9**

Radiometry – Radar Altimetry – Effect of surface roughness – Altimetry derived data – Reflectivity– Radiometry and Derived emissivity – Incorporation of data set into image analysis – Introduction to SAR – convolution – bidirectional reflectance distribution – Microwave scatterometry - side looking RADAR , SAR – Interferometry.

UNIT V **PLANETARY APPLICATION** **9**

Planetary Imaging Spectroscopy- USGS Tetracoder and Expert system - Mars Global Surveyor Mission (MGS) – Digital Elevation Model (DEM) of Mars – Mars Orbiter Camera (MOC) – Stereo and photo clinometric techniques for DEM.

TOTAL : 45 PERIODS

**OUTCOMES:**

At the End of the Course, Learners will be able to:

1. Exposure to fundamentals of planetary science or orbital mechanics
2. The principles of observing the planets
3. Knowledge of Remote Sensing methods for determining surface elevation and mapping ofplanets.

**Reference Books:**


1. Fundamental Planetary Science : Physics, Chemistry and Habitability, Jack J. Lissauer,Imke de Pater (2013) Cambridge University Press
2. Physical principles of Remote Sensing, Rees, W.G.(2013) 3rd Edn, Cambridge UniversityPress
3. Radar Remote Sensing of Planetary Surfaces, Bruce A Campbell (2011) CambridgeUniversity Press
4. Remote Sensing Application for Planetary Surfaces, Kumar Deepak (2014) LambertPublication.

| 21CE1006 | GREEN BUILDING DESIGN | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

OBJECTIVES:

- The main learning objective of this course is to prepare the students for to identify the implications of buildings and also solar energy utilization, green composites.

UNIT I **ENVIRONMENTAL IMPLICATIONS OF BUILDINGS** **9**

Energy use, carbon emissions, water use, waste disposal; Building materials: sources, methods of production and environmental Implications. Embodied Energy in Building Materials: Transportation Energy for Building Materials; Maintenance Energy for Buildings.

UNIT II **IMPLICATIONS OF BUILDING TECHNOLOGIES EMBODIED ENERGY OF BUILDINGS** **9**

Framed Construction, Masonry Construction. Resources for Building Materials, Alternative concepts. Recycling of Industrial and Buildings Wastes. Biomass Resources for buildings.

UNIT III **COMFORTS IN BUILDING** **9**

Thermal Comfort in Buildings- Issues; Heat Transfer Characteristic of Building Materials and Building Techniques. Incidence of Solar Heat on Buildings-Implications of Geographical Locations.

UNIT IV **UTILITY OF SOLAR ENERGY IN BUILDINGS** **9**

Utility of Solar energy in buildings concepts of Solar Passive Cooling and Heating of Buildings. Low Energy Cooling. Case studies of Solar Passive Cooled and Heated Buildings.

UNIT V **GREEN COMPOSITES FOR BUILDINGS** **9**

Concepts of Green Composites. Water Utilization in Buildings, Low Energy Approaches to Water Management. Management of Solid Wastes. Management of Sullage Water and Sewage. Urban Environment and Green Buildings. Green Cover and Built Environment.

TOTAL : 45 PERIODS

**OUTCOMES:**

At the End of the Course, Learners will be able to:

1. Compare conventional building and Green building with energy conservation.
2. Recycling of Industrial and Buildings Wastes and Biomass
3. Heat Transfer Characteristic of Building Materials and Building Techniques.
4. Analyze the solar energy heat in buildings.
5. Adopt Green composites for building

**Text Books :**

1. Charles. J. Kibert, Sustainable Construction: Green Building Design and Deliver, John Wiley & Sons, 2016.

**Reference Books:**

1. Osman Attmann Green Architecture Advanced Technologies and Materials. McGraw Hill, 2010.
2. Jerry Yudelson Green building Through Integrated Design. McGraw Hill, 2009.
3. Fundamentals of Integrated Design for Sustainable Building By Marian Keeler, Bill Burke

| 21ME1937 | INDUSTRIAL SAFETY | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

OBJECTIVES:

- Identify unsafe conditions and recognize unsafe alerts.
- Interpret the rules and regulations for safety operations.
- Capable of solving problem of accidents.
- Capable of solving the present for criticizing the present for improved safety.
- Collaborate and modify processes / procedures for safety.

UNIT I **INTRODUCTION** **9**

Evolution of modern safety concepts – Fire prevention – Mechanical hazards – Boilers, Pressure vessels, Electrical Exposure.

UNIT II **CHEMICAL HAZARDS** **9**

Chemical exposure – Toxic materials – Radiation Ionizing and Non-ionizing Radiation - Industrial Hygiene – Industrial Toxicology.

UNIT III **ENVIRONMENTAL CONTROL** **9**

Industrial Health Hazards – Environmental Control – Industrial Noise - Noise measuring instruments, Control of Noise, Vibration, - Personal Protection.

UNIT IV **HAZARD ANALYSIS** **9**

Industrial Health Hazards – Environmental Control – Industrial Noise - Noise measuring instruments, Control of Noise, Vibration, - Personal Protection.

UNIT V **SAFETY REGULATIONS** **9**

Explosions – Disaster management – catastrophe control, hazard control , Factories Act, Safety regulations Product safety – case studies.

TOTAL : 45 PERIODS

**OUTCOMES:**

At the End of the Course, Learners will be able to:

1. Identify and prevent chemical, environmental mechanical, fire hazard.
2. Collect, analyze and interpret the accidents data based on various safety techniques
3. Apply proper safety techniques on safety engineering and management.
4. Able to perform hazard analysis.
5. Aid to design the system with environmental consciousness by implementing safety regulation.

**Text Books:**

**1.** John V.Grimaldi, “Safety Management”, AITB S Publishers, 2003

**Reference Books:**

1. David L.Goetsch, “Occupational Safety and Health for Technologists”, Engineers and Managers, Pearson Education Ltd. 5th Edition, 2005.
2. Deshmukh L M, “Industrial Safety Management”, Tata McGraw-Hill Publishing Company Ltd.,2005
3. Safety Manual, “EDEL Engineering Consultancy”, 2000.

**Web references:**

- https://www.asme.org/codes-standards/publications-information/safety-codes-standards

- https://www.nfpa.org/Codes-and-Standards/All-Codes-and-Standards/List-of-Codes-and-Standards
- https://link.springer.com/chapter/10.1007/978-1-84882-472-0_22

**Online Courses / Resources:**

- https://nptel.ac.in/courses/110105094
- http://www.nitttrc.edu.in/nptel/courses/video/110105094/L51.html
- https://www.digimat.in/nptel/courses/video/110105094/L01.html

| 21CB1001 | INTRODUCTION TO C PROGRAMMING | L | T | P | C |
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OBJECTIVES:

- To acquire knowledge to write an algorithm and flowchart for problems
- To study and develop C programs using operators, expressions and control flow
- To learn the concept for functions and pointers
- To gather knowledge about structure and I/O
- To learn about processing of files

UNIT I **BASICS OF C PROGRAMMING** **9**

Introduction to programming paradigms, Art of Programming through Algorithms and Flowcharts -History and importance of C - Applications of C Language - Structure of C program – Basics: Data Types – Constants –Variables - Keywords – Operators: Precedence and Associativity - Expressions – Input / Output statements, Assignment statements – Decision-making statements - Switch statement - Looping statements – Pre-processor directives - Compilation process – Exercise Programs: Check whether the required amount can be withdrawn based on the available amount – Menu-driven program to find the area of different shapes – Find the sum of even numbers.

**SUGGESTED ACTIVITIES:**

- Understanding the constructs of C Language.
- Control the sequence of the program and give logical outputs
- Understanding the uses of pre-processors and various memory models

**SUGGESTED EVALUATION METHODS**

- Tutorial on conditionals and loops.
- Assignments

UNIT II **ARRAYS** **9**

Introduction to Arrays – One dimensional array: Declaration – Initialization - Accessing elements – Operations: Traversal, Insertion, Deletion, Searching - Two dimensional arrays: Declaration – Initialization - Accessing elements – Operations: Read – Print – Sum – Transpose – Multiplication- Exercise Programs: Print the number of positive and negative values present in the array – Sort the numbers using bubble sort - Find whether the given is matrix is diagonal or not.

**SUGGESTED ACTIVITIES:**

- Understanding the purpose of array
- Design and implement applications using arrays
- Develop an application to perform matrix operations using multi-dimensional arrays

**SUGGESTED EVALUATION METHODS**

- Pedagogical tools
- Assignments

UNIT III **STRINGS & POINTERS** **9**

Introduction to Strings - Reading and writing a string - String operations (without using built-in string functions): Length – Compare – Concatenate – Copy – Reverse – Substring – Insertion – Indexing – Deletion – Replacement – Array of strings –Pointers: Pointer operators – Pointer arithmetic - Exercise programs: To find the frequency of a character in a string - To find the number of vowels, consonants and white spaces in a given text - Sorting the names.

**SUGGESTED ACTIVITIES:**

- Understanding the purpose of strings
- Developing C programs using strings

**SUGGESTED EVALUATION METHODS**

- Quizzes
- Tabulate the different strings functions and its purpose

UNIT IV **FUNCTIONS** **9**

Introduction to Functions – Types: User-defined and built-in functions - Function prototype -Function definition - Function call - Parameter passing: Pass by value - Pass by reference - Built-infunctions (string functions) – Recursive functions – Exercise programs: Calculate the total amountof power consumed by 'n' devices (passing an array to a function) – Menu-driven program to countthe numbers which are divisible by 3, 5 and by both (passing an array to a function) – Replace thepunctuations from a given sentence by the space character (passing an array to a function)

**SUGGESTED ACTIVITIES:**

- Apply code reusability with functions and pointers
- Develop and implement modular applications in C using functions.

**SUGGESTED EVALUATION METHODS**

- Assignments
- Pedagogical Techniques

UNIT V **STRUCTURES, UNIONS AND FILE MANAGEMENT** **9**

Introduction to structures – Declaration – Initialization – Accessing the members – Nested Structures – Array of Structures – Structures and functions – Passing an entire structure – type def – Union - Storage classes and Visibility. Exercise programs: Compute the age of a person using structure and functions (passing a structure to a function) – Compute the number of days an employee came late to the office by considering his arrival time for 30 days (Use array of structuresand functions) - Defining and opening a file, closing a file, Input/output and Error Handling on Files

**SUGGESTED ACTIVITIES:**

- Demonstration of real-world applications using file operations.
- Implementing applications using Unions, Enumerations and typedef.
- Understanding the basics of file handling mechanisms

**SUGGESTED EVALUATION METHODS**

- Quizzes
- Assignment

TOTAL : 45 PERIODS

**OUTCOMES:**

At the End of the Course, Learners will be able to:

1. Ability to implement the algorithms and flow chart for solving mathematical andengineering problems
2. Develop C programs for real world/technical application using basic constructs

3. Implement C programs using control structures
4. Explore the usage of arrays, pointers and functions in C.
5. Implement Programs with structures and union in C.

**Text Books :**


1. ReemaThareja, "Programming in C", Oxford University Press, Second Edition, 2016.
2. Kernighan, B.W and Ritchie,D.M, "The C Programming language", Second Edition, PearsonEducation, 2015


**Reference Books:**


1. Paul Deitel and Harvey Deitel, "C How to Program with an Introduction to C++", Eighth edition, Pearson Education, 2018.
2. Yashwant Kanetkar, Let us C, 17th Edition, BPB Publications, 2020.
3. Byron S. Gottfried, "Schaum's Outline of Theory and Problems of Programming with C", McGraw-Hill Education, 1996.
4. Pradip Dey, Manas Ghosh, "Computer Fundamentals and Programming in C", Second Edition, Oxford University Press, 2013.


**Web references:**

- https://github.com/tscheffl/ThinkC/blob/master/PDF/Think
- https://freecomputerbooks.com/langCBooks.html

**Online Courses / Resources:**

- https://www.programiz.com/c-programming 2
- https://www.tutorialspoint.com/cprogramming/index.htm
- https://www.javatpoint.com/c-programming-language-tutorial
- https://www.geeksforgeeks.org/c-programming-language/
- https://en.wikibooks.org/wiki/C_Programming

| 21EC1008 | ROBOTICS AND AUTOMATION | L | T | P | C |
|---|---|---|---|---|---|
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OBJECTIVES:

- To introduce basic robotic terminologies
- To study about the sensors of robots
- To understand the kinematics of robot
- To illustrate about robotic vision
- To apply robot based concepts in AI

UNIT I **INTRODUCTION TO ROBOTS** **9**

Introduction – Robotics -Definition and origin of robotics –components and structure of robots- different types of robot – various generations of robots – degrees of freedom – Robot classifications and specifications – Asimov's laws of robotics

UNIT II **POWER SOURCES, SENSORS AND ACTUATORS** **9**

Hydraulic, pneumatic and electric drives: Design and control issues – determination of HP of motor and gearing ratio – variable speed arrangements – path determination – micro machines in robotics- machine vision – ranging – laser – acoustic – magnetic, fiber optic and tactile sensors

UNIT III **KINEMATICS OF ROBOTS** **9**

Link Description - Link-Connection Description - Convention for Affixing Frames To Links - Manipulator Kinematics- Actuator Space-Joint Space And Cartesian Space Case Studies: Kinematics Of Two Industrial Robots - frames with standard names- computational considerations.

UNIT IV **ROBOTIC VISION** **9**

Industrial application of vision controlled robotic system-process of imaging-architecture of robotics vision system-image acquisition-description of other components of vision sytems-image representation - image processing

UNIT V **AI ROBOTICS** **9**

Intelligent systems- elements of artificial intelligence- system architecture-applications of advanced robot-fuzzy logic control-advanced concept and procedures-future development-impact on employment

TOTAL : 45 PERIODS

**OUTCOMES:**

At the End of the Course, Learners will be able to:

1. Understand the evolution of robot technology and mathematically represent different types of robot.
2. Familiarize various electrical drive systems and sensors used in robotics for various applications.
3. Understand the kinematics of robotic device
4. Understand the vision controlled robotic system

5. Realize the description of components of vision sytems
6. Understand the applications of robotics in AI

**Text Books :**


1. Introduction to Robotics: Mechanics and control : J. Craig , Pearson,2008
2. R.K.Mittal and I.J.Nagrath, Robotics and Control, Tata McGraw Hill, New Delhi,4th Reprint, 2005.
3. James G. Keramas , Robot TEchnology Fundamendals India Edition.


**Reference Books:**


1. Robotics Engineering : R. Klafter, PHI learning, 2009
2. John M. Holland, "Designing Autonomous Mobile Robots-Inside the mind of an IntelligentMachine", Newnes Publication, 2004.
3. Robot : Dynamics and Control, Spong &Vidyasagar, McGraw Hill 2008.
4. Matthew T. Mason , Mechanics of Robotic Manipulation (Intelligent Robotics and Autonomous Agents) , MIT press 2022.
5. Groover, M.P., Weiss, M., Nagel, R.N., & Odrey, N.G. Industrial robotics - technology, programming, and applications.
6. Robotics and Control , Mittal R K & Nagrath I J , TMH

| 21ME1951 | SELECTION OF MATERIALS | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

OBJECTIVES:

- To expose students to the basic parameter for selection of materials and different classes of materials
- To study about the manufacturing processes and their properties, applications of materials.
- To study about the materials selection charts and materials testing methods.

UNIT I **ENGINEERING MATERIALS** **9**

Introduction – classification of engineering materials –classification metal and alloys, polymers, ceramics and glasses, composites, natural materials,-non metallic materials- smart materials - physical, metrical properties of metals - selection of materials for engineering purposes –selection of materials and shape

UNIT II **MATERIAL PROPERTIES** **9**

Mechanical properties – fatigue strength – fracture Toughness - Thermal Properties - Magnetic Properties - Fabrication Properties –electrical , optical properties - Environmental Properties , Corrosion properties –shape and size - Material Cost and Availability– failure analysis

UNIT III **MANUFACTURING PROCESSING AND ECONOMIC ANALYSIS** **9**

Interaction of Materials Selection, Design, and Manufacturing Processes - Production Processes and Equipment for Metals - Metal Forming, Shaping, and Casting - Plastic Parts Processing - Composites Fabrication Processes - Advanced Ceramics Processing – surface treatment - Resource -The Price and Availability of Materials

UNIT IV **MATERIALS SELECTION CHARTS AND TESTING** **9**

Ash by material selection charts- Professional and Testing Organizations -Testing of Metallic Materials - Plastics Testing - Characterization and Identification of Plastics - Ceramics Testing - Nondestructive Inspection.

UNIT V **APPLICATIONS AND USES** **9**

Selection of Materials for Biomedical Applications - Medical Products - Materials in Electronic Packaging - Advanced Materials in Sports Equipment - Advanced Materials in Telecommunications - Materials Selection for Wear Resistance - Using Composites - Manufacture and Assembly with Plastics, fiber and Diamond Films.

TOTAL : 45 PERIODS

**OUTCOMES:**

At the End of the Course, Learners will be able to:

1. Remember the basics and understanding the different types of availability of materials.
2. Understand the different types of material properties.
3. Apply the different types of manufacturing processing.
4. Understand the different types of material selection and material testing processes.
5. Apply the concepts of selection of materials for different applications and uses

**Text Books :**


**1.** Ashby, M. F., Materials selection in mechanical design, 3rd edition. Elsevier, 2005.

**2.** Ashby, M. F. and Johnson, K., Materials and design – the art and science of material selection in product design, Elsevier, 2002. P.

3. Field Foster, The Mechanical Testing of Metals and Alloys, 7thedition, Cousens Press, 2007.

**Reference Books:**

1. Charles, J. A., Crane, F. A. A. and Furness, J. A. G., Selection and use of engineering materials, 3rd edition, Butterworth-Heinemann, 1997.
2. Myer Kutz, Handbook of Materials Selection, John Wiley & Sons, Inc., NewYork, 2002.
3. Metals Handbook: Mechanical testing, (Volume 8) ASM Handbook Committee, 9th Edition, American Society for Metals, 1978.

**Web references:**

- http://www.utc.fr/~hagegebe/UV/MQ12/CORRECTIONS_TD/%5BASHBY99%5D%20-20Materials%20Selection%20In%20Mechanical%20Design %202Ed.pdf
- https://uomustansiriyah.edu.iq/media/lectures/5/5_2016_05_01!08_27_09_PM.pdf

**Online Courses / Resources:**

- https://onlinecourses.nptel.ac.in/noc21_me59/preview
- https://automaterials.files.wordpress.com/2018/09/selecting-material-for-engineering-applications.pdf

| 21ME1905 | TESTING OF MATERIALS | L | T | P | C |
|---|---|---|---|---|---|
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OBJECTIVES:

- To understand the codes & standards, various destructive and non destructive testing methods of materials and its industrial applications.

UNIT I **INTRODUCTION TO MATERIALS TESTING** **9**

Overview of materials, Classification of material testing, Purpose of testing, Selection of material, Development of testing, Testing organizations and its committee, Testing standards, Result Analysis, Advantages of testing.

UNIT II **MECHANICAL TESTING** **9**

Introduction to mechanical testing, Hardness test (Vickers, Brinell, Rockwell), Tensile test, Impact test (Izod, Charpy) - Principles, Techniques, Methods, Advantages and Limitations, Applications. Bend test, Shear test, Creep and Fatigue test - Principles, Techniques, Methods, Advantages and Limitations, Applications.

UNIT III **NON DESTRUCTIVE TESTING** **9**

Visual inspection, Liquid Penetrant test, Magnetic particle test, Thermography test – Principles, Techniques, Advantages and Limitations, Applications. Radiographic test, Eddy current test, Ultrasonic test, Acoustic emission- Principles, Techniques, Methods, Advantages and Limitations, Applications.

UNIT IV **MATERIAL CHARACTERIZATION TESTING** **9**

Macroscopic and Microscopic observations, Optical and Electron microscopy (SEM and TEM) - Principles, Types, Advantages and Limitations, Applications. Diffraction techniques, Spectroscopic Techniques, Electrical and Magnetic Techniques- Principles, Types, Advantages and Limitations, Applications.

UNIT V **OTHER TESTING** **9**

Thermal Testing: Differential scanning calorimetry, Differential thermal analysis. Thermo-mechanical and Dynamic mechanical analysis: Principles, Advantages, Applications. Chemical Testing: X-Ray Fluorescence, Introduction to mass spectrometry, Elemental Analysis by Inductively Coupled Plasma-Optical Emission Spectroscopy and Plasma-Mass Spectrometry.

TOTAL : 45 PERIODS

**OUTCOMES:**

At the End of the Course, Learners will be able to:

1. Identify suitable testing technique to inspect industrial component.
2. Ability to use the different technique and know its applications and limitations.
3. Carry out various NDT inspection methods and also differentiate various defect types and select the appropriate NDT methods for better evaluation.
4. Ability to analyze samples using a SEM, TEM and spectroscopes.
5. Evaluate the thermal and chemical testing methods and identifies the existence of a chemical compound in a material.

**Text Books:**


1. Baldev Raj, T.Jayakumar, M.Thavasimuthu “Practical Non-Destructive Testing”, Narosa Publishing House, 2009.
2. Cullity, B. D., “Elements of X-ray diffraction”, 3rd Edition, Addison-Wesley Company Inc., New York, 2000.
3. P. Field Foster, “The Mechanical Testing of Metals and Alloys” 7th Edition, Cousens Press, 2007.

**Reference Books:**


1. Metals Handbook: Mechanical testing, (Volume 8) ASM Handbook Committee, 9th Edition, American Society for Metals, 1978.
2. ASM Metals Handbook, "Non-Destructive Evaluation and Quality Control", American Society of Metals, Metals Park, Ohio, USA.
3. Brandon D.G., "Modern Techniques in Metallography", Von Nostrand Inc. NJ, USA, 1986.


**Web references:**

- https://webstore.ansi.org/industry/material-testing
- https://nvlpubs.nist.gov/nistpubs/ir/2015/NIST.IR.8059.pdf.https://www.thermofisher.com/in/en/home/materials-science/learning-center/applications/sem-tem-difference.html
- https://www.twi-global.com/technical-knowledge/faqs/what-is-non-destructive-testing#:~:text=Non%2Ddestructive%20testing%20(NDT),damage%20to%20the%20original%20part.
- https://www.asnt.org/MajorSiteSections/About/Introduction_to_Nondestructive_Testing.aspx

**Online Courses / Resources:**

- https://www.classcentral.com/course/swayam-theory-and-practice-of-non-destructive-testing-
- https://onlinecourses.nptel.ac.in/noc20_mm07/preview
- https://www.twi-global.com/locations/india/courses/non-destructive-testing-online-live-courses
- https://www.asminternational.org/news/industry//journal_content/56/10180/42035275/NEWS

| 21CE1007 | TEXTILE EFFLUENT TREATMENTS | L | T | P | C |
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OBJECTIVES:

- To impart awareness about the pollution created by different stages of wet processing
- To familiarize the students about the importance of water and its analysis
- To enable the students to understand about the waste water treatment plants and various treatments carried out.

UNIT I **INTRODUCTION** **9**

Constituents of water and their effect on textile wet processing, Effluent discharge standards for inland surface water public sewers, on land for irrigation, marine coastal areas and drinking water parameters, Quality requirements of water for cotton and synthetic Textile processing.

UNIT II **PRIMARY TREATMENT METHODS** **9**

Characteristics and treatment of cotton, synthetics and wool processing effluents, Reduction of pollution load, Primary treatment methods - screening, sedimentation, equalization, neutralization, coagulation and flocculation.

UNIT III **SECONDARY TREATMENT METHODS** **9**

Characteristics and treatment of cotton, synthetics and wool processing effluents, Reduction of pollution load, Primary treatment methods - screening, sedimentation, equalization, neutralization, coagulation and flocculation.

UNIT IV **TERTIARY TREATMENT METHODS** **9**

Tertiary treatment – Evaporation (solar and steam), Advanced oxidation system, Membrane technologies (MF, UF, NF & RO) ,Reverse osmosis, ion exchange and activated carbon treatment.Quality parameters at entry and exit of RO-Case Study

UNIT V **REMEDIATION OF TEXTILE EFFLUENT** **9**

Dye binding properties from Textile effluents-New methods of Textile wastewater treatment-Phyto remediation of mixture of dyes in textile effluents-Government regulation for effluent-Zero Liquid Discharge Concept (ZLD).

TOTAL : 45 PERIODS

**OUTCOMES:**

At the End of the Course, Learners will be able to:

1. Upon completion of the course, the students will be able to
2. Understand the textile processing related causes for pollution
3. Understand the effluent discharge standards and different processes involved in wastewater treatment.
4. Perform the research and development to produce zero discharge effluents

**Text Books :**


1. Rao,C.S., “Environment Pollution control Engineering”, New age International Ltd. andPublishers, N.Delhi, 2004.
2. Reife, A., and Freeman, H.S., (Ed)., “Environmental chemistry of dyes and

pigment",Wiley., London, 2000, ISBN: 047158276.

**Reference Books:**


1. Horrockks,A.R (Ed)., "Ecotextiles'98:Sustainable development", The Text.Inst., Manchester 1999, ISBN: 1855732426.
2. Modak.P., "The textile industry and the environment", UNEP:HMSO, Blackwells, Leeds,2003, ISBN: 9280713671

## SYLLABUS OF VERTICAL COURSES

## VERTICAL I: STRUCTURES

| 21CE1901 | CONCRETE STRUCTURES | L | T | P | C |
|---|---|---|---|---|---|
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**COURSE OBJECTIVE:**

- To acquire hands on experience in design and preparation of structural drawings for concrete / steel structures normally encountered in Civil Engineering practice using Computer Software Staad Pro, E-Tabs and any Structural design and analysis Software.

UNIT I **INTRODUCTION AND CODES** **9**

Geometric Parameters, Grade of concrete and steel for different elements, Exposure and cover requirements, Fire rating, Load Combinations, Serviceability Requirements, Analysis tools. Indian & International Codes for Reinforced concrete Design, Design loads , National Building Code2016,Practical building example, drawing sizes and scale.

UNIT II **LOADS ACTING ON STRUCTURES** **9**

Introduction, Dead, Live loads, Wind loading and Calculations of - force coefficients, Wind pressure, storey forces and base shears. Earthquake loading and Calculations of-acceleration coefficient, Time period, Base shear. Scheme Design, Concrete floor systems, Sizing and design of various slab systems, Beams, Reinforced Concrete Columns- Location and Shape, Design Axial Load ,sizing, Lateral Load Systems,IS1893-Requirements

UNIT III **MODELLING OF BASIC STRUCTURAL ELEMENTS** **9**

Introduction to Analysis & Modelling, Modelling of Cantilever, Portal Frame, three bay Portal Frame, 3D structuralmodels - Geometry, gravity loads, defining earthquake loads, defining wind loads, Modelling Shear walls, Practical Structural Model of building,Structural models of Floor System,Estimation of deflections.

UNIT IV **DESIGN OF STRUCTURAL ELEMENTS** **9**

Design of Beams-flexural reinforcement, shear reinforcement, Design of flat slabs-Flexural Reinforcement, shear reinforcement, Design of 2-way continuous slabs. Design of Reinforcements in Columns, Post processing , Design and arrangement of vertical reinforcement, horizontal reinforcement in the design of buildings. Design of shear walls-Sizing of elements based on Construct ability aspects like formwork, concrete placement and compaction, rebar arrangement to satisfy economy and optimum utilisation

UNIT V **DETAILING OF STRUCTURAL ELEMENTS** **9**

Development of Reinforcement, Typical details of-flatslabs ,two-way continuous slabs, beams, columns and shearwall, detailing and documentation. Case Studies:Structural analysis and design of a multi-storey building with load calculation(dead,live,wind and seismic) as per Indian standard codes using any Structural design and analysis Software

TOTAL : 45 PERIODS

**OUTCOMES:**

On completion of the course, the student is expected to be able to

1. Understandthephysicalandengineeringpropertiesofmarinesoildeposits
2. Explain the effect of wave loading on engineering properties of marine soil deposits
3. Execute investigation program for marine soil deposits
4. Design suitable marine foundation as per project requirement
5. Develop numerical model and design marine foundation subjected to wave loading

**TEXT BOOKS:**

1. Unnikrishna Pillai,S. Devdas Menon, “Reinforced Concrete Design”, Tata McGraw Hill Publishing Company Ltd., 2009.Gambhir.M.L., "Fundamentals of Reinforced Concrete Design", Prentice Hall of India PrivateLimited,NewDelhi,2006.
2. Krishnaraju.N “Design of Reinforced Concrete Structurres“,CBS Publishers &Distributors Pvt.Ltd.,NewDelhi.
3. Sinha,S.N.,“Reinforced Concrete Design”,Tata McGrawHill Publishing Company Ltd.,NewDelhi,2002.
4. Punmia.B.C.,Ashok Kumar Jain, Arun Kumar Jain, “Limit State Design of Reinforced Concrete”,Laxmi Publication Pvt.Ltd.,NewDelhi,2007.

**Reference Books:**

1. Krishnaraju.N“Design of Reinforced Concrete Structurres“,CBS Publishers &Distributors Pvt.Ltd.,NewDelhi.
2. Sinha,S.N.,“Reinforced Concrete Design”,Tata McGrawHill PublishingCompany Ltd.,NewDelhi,2002.
3. Punmia.B.C.,AshokKumarJain,ArunKumar Jain,“Limit State Design of Reinforced Concrete”,Laxmi Publication Pvt.Ltd.,NewDelhi,2007.

**Web references:**

- https://www.civilengineeringweb.com/2021/07/best-books-for-reinforced-concrete-design.html
- https://www.sanfoundry.com/best-reference-books-design-rc-structure/
- https://ostad.nit.ac.ir/payaidea/ospic/file4019.pdf

**Online Courses / Resources:**

- https://www.civilengineeringweb.com/2021/07/best-books-for-reinforced-concrete-design.html
- https://www.sanfoundry.com/best-reference-books-design-rc-structure/
- https://ostad.nit.ac.ir/payaidea/ospic/file4019.pdf
- https://onlinecourses.nptel.ac.in/noc22_me99/preview

| 21CE1902 | PREFABRICATED STRUCTURES | L | T | P | C |
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**COURSE OBJECTIVE:**

- To introduce the basic concepts of prefabrication
- To acquire the knowledge of prefabrication components and systems
- To understand the design principle in prefabrication
- To perceive the types of joints and connections in structural members
- To impart knowledge about the structural stability

UNIT I **INTRODUCTION** **9**

Need for prefabrication -Advantages and limitations – Principles of prefabrication – Modular coordination – Standarization– Loads and load combinations– Materials – Production – Transportation – Erection.

UNIT II **PREFABRICATED COMPONENTS AND SYSTEMS** **9**

Behaviour and types of structural components– roof and floor slabs – Walls panels - Shear walls - Beams - Columns – skeletal system- portal frame system-Large panel systems- block system

UNIT III **DESIGN PRINCIPLES** **9**

Design philosophy- Design of cross section based on efficiency of material used – Problems in design because of joint flexibility – Allowance for joint deformation - Demountable precast concrete systems- Design for stripping , stacking ,transportation and erection of elements

UNIT IV **JOINTS AND CONNECTIONS IN STRUCTURAL MEMBERS** **9**

Types of Joints – based on action of forces - compression joints - shear joints - tension joints - based on function - construction joints , contraction joints, expansion joints. Design of expansion joints -Dimensions and detailing - Types of sealants - Types of structural connections - Beam to Column - Column to Column - Beam to Beam - Column to foundation.

UNIT V **DESIGN FOR ABNORMAL LOADS** **9**

Progressive collapse – Codal provisions – Equivalent design loads for considering abnormal effects such as earthquakes, cyclones, etc., - Importance of avoidance of progressive collapse -case study.

TOTAL : 45 PERIODS

**OUTCOMES:**

Students will be able to

1. Understand concepts about principles of prefabrication, production, transportation, erection.
2. Acquire knowledge about panel systems, slabs, beams, shear walls and columns used in precast construction.
3. Acquire knowledge about design of cross section, joint flexibility.
4. Acquire knowledge about joints and connection in precast construction.
5. Acquire knowledge about structural stability.

**TEXTBOOKS:**


1. Bruggeling A.S. G and Huyghe G.F. "Prefabrication with Concrete", A.A. Balkema Publishers, USA,1991.
2. Lewitt,M. " Precast Concrete- Materials, Manufacture, Properties And Usage ,CRC Press, 2019
3. Alfred Steinle, Hubert Bachmann, Mathias Tillmann, Philip Thrift . "Precast Concrete Structures", Ernst & Sohn, Berlin, 2019.

**Reference Books:**


1. Koncz T., "Manual of precast concrete construction", Vol. I, II and III, Bauverlag, GMBH, 1976.
2. "Handbook on Precast Concrete Buildings", Indian Concrete Institute, 2016.
3. " Precast concrete connection details", Structural Design manual, Society for the studies in the use of precast concrete, Netherland Betor Verlag, 2009.


**Web references:**


- Gerostiza C.Z., Hendrikson C. and Rehat D.R., "Knowledge based process planning for construction and manufacturing", Academic Press Inc.
- Koncz T., "Manual of precast concrete construction", Vol. I, II and III, Bauverlag, GMBH.
- Kim s. elliott., "Precast concrete structures" and "Multi-precast concrete framed structures".
- CBRI, Building materials and components, India.


**Online Courses / Resources:**

- https://easyengineering.net/ce6016-prefabricated-structure-anna/
- https://www.sanfoundry.com/best-reference-books-design-rc-structure/
- https://srmvalliammai.ac.in/wp-content/uploads/2022/05/1917105-prefabricated-structures.pdf

| 21CE1903 | PRESTRESSED CONCRETE STRUCTURES | L | T | P | C |
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**OBJECTIVE :**

- To understand the methods and types of prestressing and to enable the students to design prestressed concrete structural elements and systems

UNIT I **INTRODUCTION – THEORY AND BEHAVIOUR 9**

Basic principles of prestressing – Classification and types – Advantages over ordinary reinforced concrete – Materials – High strength concrete and high tensile steel – Methods of prestressing – Freyssinet, Magnel, Lee-McCall and Gifford Udall anchorage systems – Analysis of sections of stresses by stress concept, strength concept and load balancing concept – Losses of prestress in post -tensioned and pre-tensioned members.

UNIT II **DESIGN FOR FLEXURE AND SHEAR 9**

Basic assumptions of flexural design – Permissible stresses in steel and concrete as per I.S.1343 Code – Different Types of sections - Design of sections of Type I and Type II post-tensioned and pre-tensioned beams –Check for flexural capacity based on I.S. 1343 Code – Influence of Layout of cables in post-tensioned beams –Location of wires in pre-tensioned beams – Design for shear based on I.S. 1343 Code.

UNIT III **DEFLECTION AND DESIGN OF ANCHORAGE ZONE 9**

Factors influencing deflections – Short-term deflections of uncracked members – Prediction of long- term deflections due to creep and shrinkage – Check for serviceability limit states. Determination of anchorage zone stresses in post-tensioned beams by Magnel's method, Guyon's method and I.S. 1343 code – design of anchorage zone reinforcement – Check for transfer bond length in pre- tensioned beams– design of anchorage zone reinforcement – Check for transfer bond length in pre- tensioned beams.

UNIT IV **COMPOSITE BEAMS AND CONTINUOUS BEAMS 9**

Analysis and design of composite beams – Shrinkage strain and its importance – Differential shrinkage - Methods of achieving continuity in continuous beams – Analysis for secondary moments – Concordant cable and linear transformation – Calculation of stresses – Principles of design.

UNIT V **MISCELANEOUS STRUCTURES 9**

Role of prestressing in members subjected to Tensile forces and compressive forces – Design of Tension members and Compression members - Design of Tanks, Pipes, Sleepers and Poles – Partial prestressing – methods of achieving partial prestressing, merits and demerits of partial prestressing.

TOTAL : 45 PERIODS

**OUTCOMES:**

Students will be able to

1. Design a prestressed concrete beam accounting for losses.
2. Design for flexure and shear.
3. Design the anchorage zone for post-tensioned members and estimate the deflection in beams.
4. Design composite members and continuous beams.
5. Design water tanks, pipes, poles and sleepers.

**TEXTBOOKS:**

1. Krishna Raju N., "Prestressed concrete", 5th Edition, Tata McGraw Hill Company, New Delhi, 2012

2. Pandit.G.S. and Gupta. S.P., "Prestressed Concrete", CBS Publishers and Distributers Pvt. Ltd, 2014 **Theory Courses**

**Reference Books:**


1. Lin T.Y. and Ned.H.Burns, "Design of prestressed Concrete Structures", Third Edition, Wiley India Pvt. Ltd.New Delhi, 2013.
2. Rajagopalan.N, "Prestressed Concrete", Narosa Publishing House, 2017.
3. Dayaratnam.P., "Prestressed Concrete Structures", Oxford and IBH, 2017
4. Sinha.N.C. And Roy.S.K. Fundamentals of Prestressed Concrete, S.Chand and Co. Ltd., 2011


**Web references:**

- "Modern Prestressed Concrete" by J R Libby
- Reinforced and Prestressed Concrete Design to Ec2: The Complete Process" by Eugene O'Brien

**Online Courses / Resources:**

- sanfoundry.com/best-reference-books-prestressed-concrete-design/
- https://railtec.illinois.edu/wp/wp-content/uploads/Nawy-2009-Prestressed-Concrete.pdf
- https://www.kerkstra.com/wpontent/uploads/2020/03/Design_Handbook_7th_Edition.pdf

| 21CE1904 | REHABILITATION / HERITAGE RESTORATION | L | T | P | C |
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**COURSE OBJECTIVE:**

- To acquire the knowledge on quality of concrete, durability aspects, causes of deterioration, assessment of distressed structures, repairing of structures, Restoration of Heritage structures and demolition procedures.

UNIT I **MAINTENANCE AND REPAIR STRATIGES** **9**

Maintenance, Repair and Rehabilitation - Facets of Maintenance - Importance of Maintenance - Various aspects of Inspection - Assessment procedure for evaluating a damaged structure - causes of deterioration.

UNIT II **STRENGTH AND DURABILITY OF CONCRETE** **9**

Quality assurance for concrete – Strength and Durability of concrete - Cracks, different types, causes-Effects due to climate, temperature, Sustained elevated Temperature, Corrosion –

UNIT III **SPECIAL CONCRETES** **9**

Polymer concrete - Sulphur infiltrated concrete - Fibre reinforced concrete - High strength concrete- High performance concrete - Self compacting concrete - Geopolymer concrete - Concrete made with industrial wastes.

UNIT IV **TESTING TECHNIQUES AND PROTECTION METHODS** **9**

Non-destructive Testing Techniques, Epoxy injection, Shoring, Underpinning, Corrosion protection techniques – Corrosion inhibitors, Corrosion resistant steels, Coatings to reinforcement, cathodic protection.

UNIT V **STRENGTHENING, REPAIR, REHABILITATION AND RESTORATION OF STRUCTURES** **9**

Strengthening of Structural elements, Repair of structures distressed due to corrosion, fire, leakage and earthquake - Restoration of Heritage structures- Case studies.

TOTAL : 45 PERIODS

**OUTCOMES:**

Students will be able to

1. Know the importance of inspection and maintenance.
2. Study the Impacts of cracks, corrosion and climate on structures.
3. Know about various special concretes
4. Understand the testing techniques and various protection measures
5. Know the Repair of structures and Restoration of Heritage structures

**TEXTBOOKS:**


1. Shetty.M.S. Jain A K., Concrete Technology - Theory and Practice, S.Chand and Company, Eighth Edition, 2019.
2. B.Vidivelli, Rehabilitation of Concrete Structures Standard Publishes Distribution.1St edition 2009.


**Reference Books:**


1. Hand book on Seismic Retrofit of Buildings, CPWD and Indian Buildings Congress, Narosa Publishers,2008.
2. Hand Book on "Repair and Rehabilitation of RCC Buildings" – Director General works CPWD ,Govt of India , New Delhi – 2002
3. P.C.Varghese, Maintenance Repair and Rehabilitation & Minor works of building, Prentice Hall India Pvt Ltd 2014.

4. Dodge Woodson, Concrete Structures, Protection, Repair and Rehabilitation,
    1. Butterworth-Heinemann, Elsevier, New Delhi 20

**Web references:**

- P.C.Varghese, Maintenance Repair and Rehabilitation & Minor works of building, Prentice Hall India Pvt Ltd 2014.
- Dodge Woodson, Concrete Structures, Protection, Repair and Rehabilitation, Butterworth-Heinemann, Elsevier, New Delhi 20

**Online Courses / Resources:**

- https://theconstructor.org/wp-content/uploads/2016/09/handbook-rrs.pdf
- https://www.civilenggnotes.com/tag/repair-and-rehabilitation-of-structures-book-free-download-pdf/
- "Repair and Rehabilitation of Reinforced Concrete Structures" by Walter F. Silva

| 21CE1905 | DYNAMICS AND EARTHQUAKE RESISTANT STRUCTURES | L | T | P | C |
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**COURSE OBJECTIVE:**

- To understand the behaviour of structures under dynamic, earthquake loading and design the structures as earthquake resistant as per codal provisions

UNIT I **INTRODUCTION TO DYNAMICS** **9**

Dynamics - Degree of freedom – Free and forced vibration - Idealization of structure as Single Degree of Freedom (SDOF) and Multi degree of freedom (MDOF) system – D'Alemberts Principles Formulation of equation of motion for SDOF system and MDOF system –- Evaluation of natural frequencies and modes - Effect of damping.

UNIT II **SEISMOLOGY** **9**

Elements of Engineering Seismology – Seismic hazard - Earthquake phenomenon – Seismo tectonics – Seismic Instrumentation – Characteristics of Strong Earthquake motion – Estimation of Earthquake Parameters – Soil Structure Interaction – Liquefaction of soil - Seismic zone map – Response spectra.

UNIT III **EARTHQUAKE EFFECTS ON STRUCTURES** **9**

Inertia force on structures – load transfer path – Effect of architectural features on behavior of structures – Hysteretic Behaviour of RCC, steel and prestressed concrete - Pinching Effect – Bouchinger Effects - Energy dissipation - P-delta effect - storey drift - Behavior of brick masonry, stone masonry and reinforced concrete structures under past earthquakes – typical failures - Causes of damage –- Lessons learnt from past earthquakes.

UNIT IV **EARTHQUAKE LOAD ANALYSIS** **9**

Design spectra – Codal provision – Different methods of earthquake analysis –- Analysis of structure by Equivalent static method – Analysis of structure by Response spectrum method – Introduction to time-history method of analysis.

UNIT V **EARTHQUAKE RESISTANT DESIGN** **9**

Philosophy of earthquake resistant design - Planning considerations and Architectural concepts - Design and detailing as per codal provisions - Design and detailing of typical flexural member and column member, Ductile detailing of beam-column joints and footing – Concept and principle of shear wall - Introduction to performance based seismic design - Seismic isolation principles and methods.

TOTAL : 45 PERIODS

**OUTCOMES:**

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

1. Develop the equations of motion for SDOF and MDOF system and to evaluate the natural frequencies and mode shapes.
2. Explain the elements of engineering seismology, characteristics of earthquake and seismic instrumentation.
3. Explain the behavior of various types of structures under earthquake
4. Determine the forces in a structure due to earthquake
5. Design earthquake resistant building structures

**TEXTBOOKS:**

1. Mario Paz, Structural Dynamics – Theory and Computations, Fifth Edition 2nd printing, CBS publishers, 2006.

2. Agarwal.P and Shrikhande.M. Earthquake Resistant Design of Structures, Prentice Hall of India Pvt. Ltd. 2011.

**Reference Books:**

1. Clough.R.W, and Penzien.J, Dynamics of Structures, Second Edition, McGraw Hill International Edition, 1995.
2. Minoru Wakabayashi, Design of Earthquake Resistant Buildings, Mc Graw – Hill Book Company, 1986.
3. Anil K Chopra, Dynamics of structures – Theory and applications to Earthquake Engineering, Prentice Hall Inc., 2007.
4. Moorthy.C.V.R., Earthquake Tips, NICEE, IIT Kanpur,2002. Publication of Bureau of Indian Standards:
5. IS 4326: 2013 Earthquake Resistant Design And Construction Of Buildings – Code of Practice
6. IS 1893: 2016 Criteria For Earthquake Resistant Design Of Structures – Part 1 General Provisions and Buildings. IS 13920:2016 Ductile Design And Detailing Of Reinforced Concrete Structures Subjected to Seismic Forces – Code of Practice

**Web references:**

- Anil K Chopra, Dynamics of structures – Theory and applications to Earthquake Engineering, Prentice Hall Inc., 2007.
- Moorthy.C.V.R., Earthquake Tips, NICEE, IIT Kanpur,2002. Publication of Bureau of Indian Standards:
- IS 4326: 2013 Earthquake Resistant Design And Construction Of Buildings – Code of Practice

**Online Courses / Resources:**

- "Dynamics of Structures: Applications to Earthquake Engineering" by A K Chopra
- Earthquake resistance design of structure by Duggal- Oxford University Press. https://www.sanfoundry.com/best-reference-books-earthquake-engineering-seismology/

| 21CE1906 | INTRODUCTION TO FINITE ELEMENT METHOD | L | T | P | C |
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**COURSE OBJECTIVE:**

- To develop a thorough understanding of the finite element analysis techniques with an ability to effectively use the tools of the analysis for solving practical problems arising in Civil Engineering.

UNIT I **INTRODUCTION** **9**

Historical Background – Mathematical Modeling of field problems in Engineering –Governing Equations – Discrete and continuous models – Boundary, Initial and Eigen Value problems– Weighted Residual Methods – Variational Formulation of Boundary Value Problems – Ritz Technique – Basic concepts of the Finite Element Method.

UNIT II **STIFFNESS MATRIX FORMULATION** **9**

Introduction to Discrete and Continua elements – Discrete Elements - Direct stiffness method - Special characteristics of stiffness matrix - Assemblage of elements – Boundary condition & reaction - 2D – truss element - 2D - beam element - Analysis of framed Structures - Basic steps in finite element analysis - Differential equilibrium equations - strain displacement relation - linear constitutive relation - Numerical methods in finite element analysis- Gauss elimination method.

UNIT III **ONE DIMENSIONAL PROBLEMS** **9**

One Dimensional Second Order Equations – Discretization – Element types- Linear and Higher order Elements – Continua Elements - Displacement models - convergence requirements. Natural coordinate systems - Shape function. Interpolation function. Linear and quadratic elements - Lagrange & Serendipity elements. Strain displacement matrix - element stiffness matrix and nodal load vector. Natural frequencies of longitudinal vibration and mode shapes.

UNIT IV **TWO DIMENSIONAL PROBLEMS** **9**

Two dimensional isoparametric elements - Four noded quadrilateral elements - triangular elements. Computation of stiffness matrix for isoparametric elements - numerical integration (Gauss quadrature) Convergence criteria for isoparametric elements.

UNIT V **ANALYSIS OF PLATES** **9**

Introduction to Plate Bending Problems - displacement functions – Analysis of Thin Plate - Analysis of Thick Plate- Analysis of Skew Plate, Finite Element Analysis of Shell, plane stress and plane strain analysis, Example problem using any general-purpose finite element software

TOTAL : 45 PERIODS

**OUTCOMES:**

1. To understand the basics of finite element formulation.
2. To formulate the stiffness matrix for beam, truss and framed structures.
3. To apply finite element formulations to solve one-dimensional problems.
4. To apply finite element method to solve two dimension problems.
5. To apply finite element method to analyze plate bending problems.

**TEXTBOOKS:**


1. Rao, S.S., “The Finite Element Method in Engineering”, 6th Edition, ButterworthHeinemann,2018.
2. Reddy,J.N. “Introduction to the Finite Element Method”, 4thEdition, Tata McGrawHill,2018.

**Reference Books:**


1. Krishnamoorthy, C. S, Finite Element Analysis - Theory and Programming, McGraw - Hill, 1995.
2. David Hutton, Fundamentals of Finite Element Analysis, Tata McGraw Hill Publishing Company Limited, New Delhi, 2005.
3. G.R. Liu and S.S.Quek, Finite Element Method: A Practical Course, Butterworth-Heinemann; 1st edition (21February 2003)
4. Chennakesava R. Alavala Finite Element Methods: Basic Concepts and Applications, Prentice Hall Inc., 2010.
5. R. T. Chandrupatla and A. D. Belegundu, Introduction to Finite Elements in Engineering, PHI Learning Pvt Ltd, New Delhi, 1997.
6. S. S. Bhavikatti, Finite Element Analysis, New Age Publishers, 2007.


**Web references:**


- Chennakesava R. Alavala Finite Element Methods: Basic Concepts and Applications, Prentice Hall Inc., 2010.
- R. T. Chandrupatla and A. D. Belegundu, Introduction to Finite Elements in Engineering, PHI Learning Pvt Ltd, New Delhi, 1997.
- S. S. Bhavikatti, Finite Element Analysis, New Age Publishers, 2007.


**Online Courses / Resources:**

- Introduction to the Finite Element Method" by J N Reddy
- Introduction to Finite Elements in Engineering" by T R Chandrupatla and A D Belegundu
- https://www.sanfoundry.com/best-reference-books-finite-element-methods/

| 21CE1907 | STEEL STRUCTURES | L | T | P | C |
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**COURSE OBJECTIVE:**

- To acquire hands on experience in design and preparation of structural drawings for steel structures like industrial buildings, steel framed buildings using structural design software and detailed drawing softwares.
- To introduce the students to design of light gauge steel structures

UNIT I **DESIGN ASPECTS AND LOADS ON A STEEL BUILDING** **9**

Inputs for the design of a steel building - Design basis report, covering Site Data, geometrical, functional and structural requirements for its end usage - material specifications - Methods of designing a steel building. Calculating the various loads acting on a steel building - Vertical & Lateral loads - Effects of each loads separately and in combination – Dead, superimposed dead, live, temperature, MEP service loads - Lateral loads due to Wind and Seismic effects.

UNIT II **SELECTION OF LOAD RESISTING SYSTEM AND MODELLING OF STRUCTURE** **9**

Studying the layout plans of the structure - Selection of load resisting systems - Load flow in each system - Satisfying Stability and strength of the structure - Vertical and Lateral load resisting systems analysis and design - Geometric and structural parameters of the structure - Loading the structure - Interpretation of the results of the software – Analysis and Design of a multi-storeyed building.

UNIT III **DESIGN OF VARIOUS ELEMENTS OF A STEEL BUILDING** **9**

Manual and Software aided design – Beams, columns, floors, bracings, purlins/girts and facades, base plates and anchor bolts – Various loads, different conditions of supports, exposure, and purpose of use - Design of Connections between the members – bolted and welded, moment and shear connections

UNIT IV **DESIGN OF AN INDUSTRIAL BUILDING** **9**

Functional requirements - Serviceability Requirements - Structural Configurations - Selection of sections as per requirements - Configuration of the elements, connectivity - Analysis and design of different types of trusses – – Design of Gantry Girders – Design of gable frames – Design of steel columns for combined loading - Analysis and design of industrial buildings - Study of General assembly drawings - Fabrication processes - Fabrication, logistics & erection – Sequence of erection - Inspection of a completed structure.

UNIT V **DESIGN OF LIGHT GAUGE STEEL STRUCTURES** **9**

Philosophy of design of light gauge steel members, Direct Strength Method (DSM) ,Effective width method (EWM) – Concept of buckling, local buckling and post-buckling strength - Analysis and design of Compression members– Analysis and design of flexural members, Lateral buckling of beams, Shear Lag, Flange Curling – Design of wall panels - Analysis and design of Sway and non-sway frames - Manual and Computer aided modelling.

TOTAL : 45 PERIODS

**OUTCOMES:**

Students will be able to

1. Plan the layout of the structure and calculate the loads of the steel structure.
2. Select a load resisting system, model the structure and interpret the results.
3. Design the various elements of a steel buildings
4. Design a typical industrial building
5. Design the various elements of a cold –formed steel buildings

**TEXTBOOKS:**

1. Subramanian N, Design of Steel Structures, Oxford University Press, New Delhi, 2016
2. Negi L.S. “Design of steel structures” McGraw Hill Co., New Delhi, 2014
3. Duggal S.K., Design of Steel Structures, Tata McGraw Hill, Publishing Co. Ltd., New Delhi,2010

**Reference Books:**

1. Gambhir M L, Fundamentals of Structural Steel Design, McGraw Hill Education India Pvt Limited, 2013
2. Jack C. McCormac and Stephen F Csernak, Structural Steel Design, Pearson Education Limited, 2013.
3. Sarwar Alam Raz, Structural Design in Steel, New Age International Publishers, 2014
4. Gaylord E H, Gaylord N C and Stallmeyer J E, “Design of Steel Structures”, 3edition, McGraw HillPublications, 1992
5. Salmon, Johnson & Malhas,” Steel Structures: Design and Behavior, 4th Edition, Harper Collins CollegePublisher, 1996
6. Bhavikatti S.S, Design of Steel Structures, Ik International Publishing House, New Delhi,2017.
7. Wie Wen Yu, Design of Cold Formed Steel Structures, McGraw Hill Book Company, 1996
8. www.nptel.ac.in
9. http://www.steel-insdag.org/TM_Contents.asp

**Web references:**

- Bhavikatti S.S, Design of Steel Structures, Ik International Publishing House, New Delhi,2017.
- Wie Wen Yu, Design of Cold Formed Steel Structures, McGraw Hill Book Company, 1996
- www.nptel.ac.in
- http://www.steel-insdag.org/TM_Contents.asp

**Online Courses / Resources:**

- https://www.sanfoundry.com/best-reference-books-advance-design-steel-structures/
- https://www.steelconstruction.info/images/6/65/Handbook_of_Structural_Steelwork_EE_55-13.pdf
- Steel Structures: Design and Practice" by N Subramanian

## VERTICAL II CONSTRUCTION TECHNIQUES AND PRACTICES

| 21CE1908 | FORMWORK ENGINEERING | L | T | P | C |
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OBJECTIVES:

- On completion of this course the students will be able to know the detailed planning of formwork, design of forms and erection of formwork..

UNIT I **INTRODUCTIONTOFORM WORK** **9**

Introduction to Formwork and false work, Temporary work systems, Requirements, Construction planning and site constraints, Selection, and Classification (Types) of Formwork, General objectives of formwork building – Planning for safety – Development of a Basic System – Key Areas of cost reduction – Planning examples – Overall Planning – Detailed planning – Overall programme – Detailed programme – Costing – Planning crane arrangements – Site layout plan – Transporting plant -Formwork beams – Scaffold frames – Framed panel formwork.

UNIT II **FORM WORK MATERIALS ASSESORIES & PRESSURES** **9**

Formwork Materials, Accessories and consumables– Application of tools, Reconstituted wood- Steel Aluminum Plywood- Types and grades Standard units- Corner units– Pass units, Calculation of labour constants- Formwork hours- Labour Requirement. Hardware and fasteners- Nails in Plywood Allowable withdrawal load and lateral load. Pressures on formwork- Examples- Finish- Sheathing boards workings tresses- Repetitive member stress. Vertical loads for design of slab forms-Uplift onshores-Laterals loads on slabs and walls.

UNIT III **FORMWORK DESIGN** **9**

Concepts, Formwork Systems – components, assembly, De-shuttering, safety of work and Design for Tall Structures, Foundation Wall, Column, Slab and Beam formworks. Design of Decks and False works. Effects of various loads. Loading and moment of formwork, IS Code provisions.

UNIT IV **FORMWORK FOR SPECIAL STRUCTURES** **9**

Formwork for Bridge Structures, Shells, Domes, Folded Plates, Overhead Water Tanks, Natural Draft Cooling Tower, Nuclear Reactor, Tunnel, Lift Shaft, stairs and Formwork for Precast Concrete. Various climbing system, Table lifting system.

UNIT V **CASESTUDIES** **9**

Formwork failures: Causes of failures – Inadequate shoring inadequate bracing of members -improper vibration – Premature stripping Errors in design – Case studies – Finish of exposed concrete design deficiencies – Safety factors – Prevention of rotation – Stripping sequence – failure formwork issues in multi – story building construction – vertical and horizontal elements used in the industry.

TOTAL : 45 PERIODS

**OUTCOMES:**

At the End of the Course, Learners will be able to:

1. To understand the overall and detailed planning of formwork.
2. To impart knowledge on formwork materials, accessories, pressures and labour requirement.
3. To develop the conceptual understanding of design, construction and erection of formwork.

4. To impart the knowledge about different types of formwork used for special structures.
5. To understand the errors in design and judge the formwork failures in case studies.

**TEXT BOOKS:**


1. Peurify R.Land Oberlender G.D, Formwork for Concrete Structures, McGraw Hill Education India, 2015
2. JhaKN,Formwork for Concrete Structures, Tata McGraw Hill Education,2012.


**Reference Books:**


1. Austin,C.K.,Formwork for Concrete,Cleaver-HumePressLtd.,London,1996.
2. Hurd,M.K.,Formwork for Concrete, Special Publication No.4, American Concrete Institute,Detroit,1996
3. MichaelP.Hurst, Construction Press, London andNewYork,2003.
4. Christopher Souder,(2014),Temporary Structure Design, Wiley Publications, London.
5. IS14687:1999, Falsework for Concrete Structures-Guidelines, BIS.

| 21CE1909 | CONSTRUCTION EQUIPMENT AND MACHINERY | L | T | P | C |
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| | | 3 | 0 | 0 | 3 |

OBJECTIVES:

- To train the students in field of construction equipment and machineries so as to have a firsthand knowledge of practical problems in carrying out engineering tasks. To develop skills in facing and solving the field problems using construction equipment like bull dozer, concrete mixer, crane sand scraper etc.,

**STRATEGY:**

The students individually undertake training in reputed civil engineering equipment companies, readymix concrete plants, precast/prefabricated companies for the specified duration. At the end of the training, a report on the work done will be prepared and presented. The students will be evaluated through a viva-voce examination by a team of internal staff.

TOTAL : 45 PERIODS

**OUTCOMES:**

At the end of the course the student will be able to understand the output of construction equipment and machineries

1. To implement the text book knowledge into practice.
2. To analyse the concepts of developments and implementation of new construction equipment**.**
3. To analyse the concepts of developments and implementation of new construction equipment.
4. To develop a user friendly construction equipment and machinery model.
5. To analyse the cost effectiveness of using construction equipment and machinery

| 21CE1910 | SUSTAINABLE CONSTRUCTION AND LEAN CONSTRUCTION | L | T | P | C |
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OBJECTIVES:

- To impart knowledge about sustainable construction and to understand the concepts of sustainable materials, energy calculations, green buildings and environmental effects.

UNIT I **INTRODUCTION & 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-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 : 45 PERIODS

**OUTCOMES:**

On completion of the course, the student is expected to be able to

1. Describe the various sustainable materials used in construction.
2. Explain the method of estimating the amount of energy required for building.
3. Describe the features of LEED,TERI and GRIHA ratings of buildings.
4. Explain the core concepts of lean construction tools and techniques and their importance in achieving better productivity.
5. Apply lean tools & techniques to achieve sustainability in construction projects

**Reference Books:**


1. Charles J Kibert, Sustainable Construction: Green Building Design & Delivery, 4thEdition, Wiley Publishers 2016.
2. Steve Goodhew, Sustainable Construction Process, Wiley Blackwell, UK, 2016.
3. Craig A. Langston & Grace K.C. Ding, Sustainable Practices in the Built Environment, Butterworth Heinemann Publishers,2011.
4. Ballard. G.,Tommelein. I. Koskela. L.and Howell.G., Lean construction tools and techniques, 2002.
5. Salem.O., Solomon.J., Genaidy.A and Luegring. M., Site implementation and Assessment of Lean Construction Techniques, Lean Construction Journal, 2005.

| 21CE1911 | CONSTRUCTION MANAGEMENT AND SAFETY | L | T | P | C |
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OBJECTIVES:

- To study and understand the formulation, costing of construction projects, scheduling and various safety concepts and its requirements applied to construction projects.

UNIT I **GENERAL OVER VIEW AND PROJECT ORGANIZATION** **6**

Introduction- Inter disciplinary nature of modern construction projects– execution of project– evaluation of bits– resource management.

UNIT II **ESTIMATION OF PROJECT COST & ECONOMICS** **6**

Estimating quantities– description of items– estimation of project cost– running account bills– decision making in construction projects– depreciation of construction equipment– case study.

UNIT III **PLANNING AND SCHEDULING** **6**

Introduction – project scheduling – uncertainties in duration of activities using PERT– Project monitoring and control system– resource levelling and allocation– crashing of network.

UNIT IV **SAFETY DURING CONSTRUCTION** **6**

Basic terminology in safety- types of injuries- safety pyramid- Accident patterns-Planning for safety budget, safety culture- Introduction to OSHA regulations - Site safety programs - Job Hazard analysis, accident investigation & accident indices- violation, penalty.

UNIT V **SAFE OPERATING PROCEDURES** **6**

Safety during alteration, Demolition works- Earthwork steel construction, Temporary structures, masonry & concrete construction, cutting & welding- Construction equipment, materials handling-disposal & hand tools- Other hazards– fire, confineds paces, electrical safety

TOTAL : 30 PERIODS

**LAB**

1. Introduction to various construction management software
2. Planning and creating new project
3. Scheduling and constraints using PRIMAVERA
4. Project cost management using PRIMAVERA
5. Construction project safety management using BIM

**OUTCOMES:**

On completion of the course, the student is expected to be able to

1. Perform formulations of projects.
2. Analyze project costing.
3. Identify and estimate the activity in the construction.
4. Develop the knowledge on accidents and their causes.
5. Plan, asses, analyze and manage the construction project sites

**Reference Books:**


1. Barcus.S.W. and Wilkinson.J.W, Hand Book of Management Consulting Services, McGrawHill, NewYork, 1986.
2. St Joy.P.K., Total Project Management- The Indian Context, NewDelhi, Macmillan IndiaLtd., 1992.
3. Albert Lester, Project Management, Planning and Control, 7$^{th}$Edition, Butterworth-Heinemann, USA, 2017.
4. Patrick.X. W.Zou, RizaYosiaSunindijo, Strategic Safety Management in Construction and Engineering John Wiley & Sons, Ltd. 2015.

| 21CE1912 | ADVANCED CONSTRUCTION TECHNIQUES | L | T | P | C |
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OBJECTIVES:

- To study and understand the latest construction techniques applied to engineering construction for substructure, superstructure, special structures, rehabilitation and strengthening techniques and demolition techniques.

UNIT I **SUBSTRUCTURE CONSTRUCTION** **9**

Construction Methodology- Box jacking- Pipe jacking- Under water construction of diaphragm walls and basement - Tunneling techniques- Piling techniques- Driving well and caisson– sinking cofferdam- cable anchoring and grouting- Driving diaphragm walls, Sheet piles- Laying operations for built up off shore system- Shoring for deep cutting- Large reservoir construction- wellpoints– Dewatering for underground open excavation.

UNIT II **SUPER STRUCTURE CONSTRUCTION FOR BUILDINGS** **9**

Vacuum dewatering of concrete flooring – Concrete paving technology – Techniques of construction for continuous concreting operation in tall buildings of various shapes and varying sections – Erection techniques of tall structures, Large span structures – launching techniques for heavy decks – in-situ prestressing in high rise structures, Post tensioning of slab- aerial transporting – Handling and erecting lightweight components on tall structures metal deck concrete flooring/roofing

UNIT III **CONSTRUCTION OF SPECIAL STRUCTURES** **9**

Erection of lattice towers - Rigging of transmission line structures – Construction sequence in cooling towers, Silos, chimney, sky scrapers - Bow string bridges, Cable stayed bridges – Launching and pushing of box decks – Construction of jetties and break water structures – Construction sequence and methods in domes – Support structure for heavy equipment and machinery in heavy industries – Erection of articulated structures and space decks, precast concrete erection/temporary propping/connections.

UNIT IV **REHABILITATION AND STRENGTHENING TECHNIQUES** **9**

Seismic retrofitting - Strengthening of beams - Strengthening of columns - Strengthening of slab - Strengthening of masonry wall, Protection methods of structures, Mud jacking and grouting for foundation – Micro piling and underpinning for strengthening floor and shallow profile - Sub grade water proofing, Soil Stabilization techniques.

UNIT V **DEMOLITION** **9**

Demolition Techniques, Demolition by Machines, Demolition by Explosives, Advanced techniques using Robotic Machines, Demolition Sequence, Dismantling Techniques, Safety precaution in Demolition and Dismantling.

TOTAL : 45 PERIODS

**OUTCOMES:**

On completion of the course, the student is expected to be able to

1. Understand the modern construction techniques used in the substructure construction.
2. Demonstrate knowledge and understanding of the principles and concepts relevant to superstructure construction for buildings
3. Understand the concepts used in the construction of special structures
4. Knowledge on Various strengthening and repair methods for different cases.

5. Identify the suitable demolition technique for demolishing a building.

**Reference Books:**


1. Jerry Irvine, Advanced Construction Techniques, CA Rocketr, 1984
2. Patrick Powers. J., Construction Dewatering: New Methods and Applications, John Wiley & Sons, 1992.
3. Peter.H.Emmons, "Concrete repair and maintenance illustrated", Galgotia Publications Pvt. Ltd., 2001.Press, 2008.
4. Robertwade Brown, Practical foundation engineering hand book, McGraw Hill Publications, 1995.
5. Sankar, S.K. and Saraswati, S., Construction Technology, Oxford University Press, NewDelhi, 2008

| 21CE1913 | ENERGY EFFICIENT BUILDINGS | L | T | P | C |
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OBJECTIVES:

- To study the design of energy efficient buildings which balances all aspects of energy, lighting, space conditioning and ventilation by providing a mix of passive solar design strategies and to learn the use of materials with low embodied energy

UNIT I **INTRODUCTION** **9**

Climate adapted and climate rejecting buildings – Heat Transfer – Measuring Conduction – Thermal Storage – Measurement of Radiation – The Green house Effect – Convection – Measuring latent and sensible heat – Psychrometry Chart – Thermal Comfort – Microclimate, Site Planning and Development – Temperature – Humidity – Wind – Optimum Site Locations – Sun Path Diagrams – Sun Protection – Types of Shading Devices – Design responses to energy conservation strategies

UNIT II **PASSIVE SOLAR HEATING AND COOLING** **9**

General Principles of passive Solar Heating – Key Design Elements – Sunspace – Direct gain – Trombe Walls, Water Walls – Convective Air loops – Concepts – Case Studies – General Principles of Passive Cooling – Ventilation – Principles – Case studies – Courtyards – Roof Ponds – Cool Pools – Predicting ventilation in buildings – Window Ventilation Calculations – Room Organization Strategies for Cross and Stack Ventilation – Radiation – Evaporation and dehumidification – Wind Catchers – Mass Effect – Zoning – Load Control – Air Filtration and odour removal.

UNIT III **DAYLIGHTING AND ELECTRICAL LIGHTING** **9**

Materials, components and details – Insulation – Optical materials – Radiant Barriers – Glazing materials – Glazing Spectral Response – Day lighting – Sources and concepts –Building Design Strategies – Case Studies – Daylight apertures – Light Shelves – Codal requirements – Day lighting design – Electric Lighting – Light Distribution – Electric Lighting control for day lighted buildings – Switching controls – Coefficient of utilization – Electric Task Lighting – Electric Light Zones – Power Adjustment Factors.

UNIT IV **HEAT CONTROL AND VENTILATION** **9**

Hourly Solar radiation – Heat insulation – Terminology – Requirements – Heat transmission through building sections – Thermal performance of Building sections – Orientation of buildings – Building characteristics for various climates – Thermal Design of buildings – Influence of Design Parameters – Mechanical controls – Examples. Ventilation – Requirements – Minimum standards for ventilation – Ventilation Design – Energy Conservation in Ventilating systems – Design for Natural Ventilation – Calculation of probable indoor wind speed.

UNIT V **DESIGN FOR CLIMATIC ZONES** **9**

Energy efficiency – An Overview of Design Concepts and Architectural Interventions – Embodied Energy – Low Embodied Energy Materials – Passive Downdraft Evaporative Cooling – Design of Energy Efficient Buildings for Various Zones – Cold and cloudy – Cold and sunny – Composite – Hot and dry – Moderate – Warm and humid – Case studies of residences, office buildings and other buildings in each zones – Commonly used software packages in energy efficient building analysis and design - Energy Audit – Certification.

TOTAL : 45 PERIODS

**OUTCOMES:**

On completion of the course, the student is expected to be able to

1. Explain environmental energy supplies on buildings.
2. Explain the passive solar heating, cooling system.

3. Discuss the various aspects of day- lighting and electrical lighting in a building.
4. Predict and design building ventilation and heat control for indoor comfort.
5. Design a building for climatic zone and apply simulation programs of buildings to perform energy Calculations.

**Reference Books:**


1. Brown, G.Z. and DeKay, M., Sun, Wind and Light - Architectural Design Strategies, John Wiley and Sons Inc, 2001
2. Energy Conservation Building Code, Bureau of Energy Efficiency, New Delhi,2007.
3. Handbook on Functional Requirements of Buildings Part 1 to 4 SP : 41 ( S and T) 1995
4. Majumdar, M (Ed), Energy - Efficient Buildings in India, Tata Energy Research Institute, Ministry of Non Conventional Energy Sources, 2002.
5. Moore, F., Environmental Control System, McGraw Hill Inc. 2002.
6. Tyagi, A.K. (Ed). Handbook on Energy Audits and Management Tata Energy Research Institute, 2000.

| 21CE1914 | DIGITALIZED CONSTRUCTION LAB | L | T | P | C |
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OBJECTIVES:

- To train the students in field of digitalization of construction. Students can be trained in the latest software relevant to construction industry

**List of Experiments**

To implement the digital knowledge in construction (use relevant softwares)

1. Introduction and understanding of Primavera project planner for construction
2. Using Primavera project planner, update the schedule of the project of a construction project.
3. Introduction and understanding of MS Project for a construction project
4. Using MS project, schedule the construction project planning
5. Introduction to BIM in construction projects
   a. Development of BIM for small construction project
6. Progress the work flows in construction project using BIM
7. Development of bid management for a small firm construction industry using software.

TOTAL : 90 PERIODS

**OUTCOMES:**

At the end of the course the student will be able to understand the output of digitalization of construction

1. To understand the importance of latest software in a construction industry.
2. To plan a construction project using Primervera
3. To plan a construction project using MS project
4. To develop a BIM information model
5. To analyse the bid management and its effectiveness using bid management software

## VETRICAL III: GEO TECHNICAL

| 21CE1915 | GEO-ENVIRONMENTAL ENGINEERING | L | T | P | C |
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OBJECTIVES:

- The student acquires the knowledge on the Geotechnical engineering problems associated with soil contamination, safe disposal of waste and remediate the contaminated soils by different techniques hereby protecting environment

UNIT I **SOIL – WASTE INTERACTION** **9**

Role of Geo-environmental Engineering – sources, generation and classification of wastes – causes and consequences of soil pollution – case studies in soil failure -factors influencing soil pollutantinteraction – modification of index, chemical and engineering properties – physical and physio- chemical mechanisms.

UNIT II **CONTAMINANT TRANSPORT AND SITE CHARACTERISATION** **9**

Transport of contaminant in subsurface – advection, diffusion, dispersion – chemical process – biological process, sorption, desorption, precipitation, dissolution, oxidation, complexation, ion exchange, Volatization, biodegradation – characterization of contaminated sites – soil and rock data-hydrological and chemical data – analysis and evaluation.

UNIT III **WASTE CONTAINMENT AND REMEDIATION OF CONTAMINATED SITES** **9**

In-situ containment – vertical and horizontal barrier – surface cover – ground water pumping system on subsurface drain – soil remediation – Soil Vapour extraction, soil waste stabilization, solidificationof soils, electro kinetic remediation, soil heating, vitrification, bio remediation, Phyto-remediation – ground water remediation – pump and treat , In-situ flushing, permeable reacting barrier, In-situ air sparing.

UNIT IV **LANDFILLS AND SURFACE IMPOUNDMENTS** **9**

System – Source and characteristics of waste - site selection for landfills – components of landfills – liner soil, geomembrane, geosynthetic clay, geo-composite liner system – leachate collection – final cover design – monitoring landfill - Environmental laws and regulations**.**

UNIT V **STABILISATION OF WASTE** **9**

Evaluation of waste materials – flyash, municipal sludge, plastics, scrap tire, blast furnace slag, construction waste, wood waste and their physical, chemical and biological characteristics – potentialreuse – utilization of waste and soil stabilization.

TOTAL : 45 PERIODS

**OUTCOMES:**

At the End of the Course, Learners will be able to:

1. Understand the various causes and consequences of waste interaction with soil and their modification.
2. Understand the various mechanism of transport of contaminants into the subsurface and characterization of contaminated sites and their risk analysis.
3. Understand on how to decontaminate the site so as to reuse the site for human settlement.
4. Understand how to safely dispose the waste through different containment process.
5. Expose on how to convert the waste into a resource material through soil waste stabilization techniques with or without chemical stabilization.

**Reference Books:**


1. Daniel B.E, Geotechnical Practice for waste disposal, Chapman & Hall, London, 1993.
2. Hari D. Sharma and Krishna R.Reddy, Geo-Environmental Engineering – John Wiley and Sons,INC, USA, 2004.
3. Westlake, K., Landfill Waste pollution and Control, Albion Publishing Ltd., England, 1995.
4. Wentz, C.A., Hazardous Waste Management, McGraw Hill, Singapore, 1989.
5. Proceedings of the International symposium of Environmental Geotechnology (Vol.I and II),Environmental Publishing Company, 1986 and 1989.
6. Ott, W.R., Environmental Indices, Theory and Practice, Ann Arbor, 1978.
7. Fried, J.J., Ground Water Pollution, Elsevier, 1975.
8. ASTM Special Tech. Publication 874, Hydraulic Barrier in Soil and Rock, 1985.
9. Lagrega, M.d., Buckingham, P.L., and Evans, J.C., Hazardous Waste Management, McGrawHill, Inc. Singapore, 1994.

| 21CE1916 | GROUND IMPROVEMENT TECHNIQUES | L | T | P | C |
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OBJECTIVES:

- Students will be exposed to various problems associated with soil deposits and methods to evaluate them. The different techniques will be taught to them to improve the characteristics of difficult soils as well as design techniques required to implement various ground improvement methods**.**

UNIT I **HYDRAULIC MODIFICATIONS** **9**

Scope and necessity of ground improvement in Geotechnical engineering basic concepts. Drainage GroundWater lowering by well points, deep wells, vacuum and electro-osmotic methods. Stabilization by thermal and freezing techniques - Applications.

UNIT II **MECHANICAL MODIFICATIONS** **9**

Insitu compaction of granular and cohesive soils, Shallow and Deep compaction methods – Sand piles – Concept, design, factors influencing compaction. Blasting and dynamic consolidation design and relative merits of various methods – Soil liquefaction mitigation methods.

UNIT III **PHYSICAL MODIFICATION** **9**

Preloading with sand drains, fabric drains, wick drains – theories of sand drain - Stone column with and without encased, lime stone – functions – methods of installation – design, estimation of load carrying capacity and settlement. Root piles and soil nailing – methods of installation – Design and Applications.

UNIT IV **MODIFICATION BY INCLUSIONS** **9**

Reinforcement – Principles and basic mechanism of reinforced earth, simple design: Synthetic and natural fiber based Geotextiles and their applications. Filtration, drainage, separation, erosion control.

UNIT V **CHEMICAL MODIFICATION** **9**

Grouting – Types of grout – Suspension and solution grouts – Basic requirements of grout. Grouting equipment – injection methods – jet grouting – grout monitoring – Electro – Chemical stabilization – Stabilization with cement, lime - Stabilization of expansive clays.

TOTAL : 45 PERIODS

**OUTCOMES:**

At the End of the Course, Learners will be able to:

1. Identify and evaluate the deficiencies in the deposits of the given project area and improve its characteristics by hydraulic modifications.
2. Improve the ground characteristics by mechanical modifications using various method and design the system
3. Improve the ground characteristics by physical modifications using various method and design the system
4. Improve the characteristics of soils by various reinforcement techniques and design
5. Analyse the ground and decide the suitable chemical method for improving its characteristics

**Reference Books:**


1. Pappala, A.J.,Huang,J., Han, J., and Hoyos, L.R., Ground Improvement and Geosynthetics; Geotechnicalspecial publication No.207, Geo Institute, ASCE, 2010
2. Cox, B.R., and Grifiths S.C., Practical Recommendation for Evaluation and mitigation of SoilLiquefaction in Arkansas, (Project Report), 2010.
3. Day, R.W., Foundation Engineering Handbook, McGraw – Hill Companies, Inc. 2006.
4. Rowe, R.K., Geotechnical and Geo-environmental Engineering Handbook, Kluwer Academic Publishers,2001.
5. Das, B.M., Principles of Foundation Engineering, Fourth Edition, PWS Publishing, 1999.
6. Moseley, M.P., Ground Treatment, Blackie Academic and Professionals, 1998.
7. Koerner, R.M., Designing with Geosynthetics, Third Edition, Prentice Hall 1997.
8. Hehn, R.W., Practical Guide to Grouting of Underground Structures, ASCE, 1996.
9. Jewell, R.A., Soil Reinforcement with Geotextiles, CIRIA, London, 1996.
10. Koerner, R.M. and Welsh, J.P., Construction and Geotechnical Engineering using Synthetic Fabrics, JohnWiley, 1990.
11. Han,J., Principles and Practice of Ground Improvement, John Wiley and Sons, New Jersey, Canada 2015.
12. Jones, J.E.P., Earth Reinforcement and Soil Structure, Butterworths, 1985.
13. Manfred R. Hausmann, Engineering Principles of Ground Modifications, McGraw-Hill PublishingCompany, New York

| 21CE1917 | SOIL DYNAMICS AND MACHINE FOUNDATIONS | L | T | P | C |
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OBJECTIVES:

- To design different types of machine foundations based on the dynamic properties of soils and to get an exposure on vibration isolation techniques.

UNIT I **THEORY OF VIBRATION** **9**

Introduction – Nature of dynamic loads – Basic definitions – Simple harmonic motion – Fundamentals of vibration – Single degree and multi degree of freedom systems – Free vibrations of spring – Mass systems– Forced vibrations – Resonance – Viscous damping – Principles of vibrations measuring systems – Effect of transient and pulsating loads.

UNIT II **DYNAMIC SOIL PROPERTIES** **9**

Dynamic stress-strain characteristics – Principles of measuring dynamic properties – Laboratory techniques – Field tests – Block vibration test – Factors affecting dynamic properties – Typical values. Mechanism of liquefaction – Influencing factors – Evaluation of liquefaction potential – Analysis from SPT test – Dynamic bearing capacity – Dynamic earth pressure.

UNIT III **MACHINE FOUNDATIONS** **9**

Introduction – Types of machine foundations – General requirements for design of machine foundations – Design approach for machine foundation – Vibration analysis – Elastic Half-Space theory – Mass-spring- dashpot model – Permissible amplitudes – Permissible bearing pressures.

UNIT IV **DESIGN OF MACHINE FOUNDATION** **9**

Evaluation of design parameters – Types of Machines and foundations – General requirements – their importance – Analysis and design of block type and framed type machine foundations – Modes of vibration of a rigid foundation – Foundations for reciprocating machines, impact machines, Two – Cylinder vertical compressor, Double-acting steam hammer –Codal recommendations - Emprical approach – Barken's method – Bulb of pressure concept – Pauw's analogy – Vibration table studies.

UNIT V **VIBRATION ISOLATION** **9**

Vibration isolation – Types of isolation – Transmissibility – Passive and active isolation – Methods of isolation – Use of springs and damping materials – Properties of isolating materials – Vibration control of existing machine foundation.

TOTAL : 45 PERIODS

**OUTCOMES:**

At the End of the Course, Learners will be able to:

1. Acquire knowledge to apply theories of vibration to solve dynamic soil problems.
2. Evaluate the dynamic properties of soil using laboratory and field tests.
3. Acquire basic knowledge about machine foundations and design various types of machine foundation.

4. To know and capable of selecting the types of vibration isolation materials.
5. To apply vibration isolation techniques for various field problems.

**Reference Books:**


1. KameswaraRao, N.S.V., Dynamics soil tests and applications, Wheeler Publishing, New Delhi, 2000.
2. Prakash, S and Puri, V.K., Foundations for machines, McGraw Hill, 1987.
3. Moore, P.J.,Analysis and Design of Foundations for Vibrations, Oxford and IBH, 1985.
4. Vaidyanathan, C.V., and Srinivasalu, P., Handbook of Machine Foundations, McGraw Hill, 1995.
5. Arya, S., O'Nelt; S., Design of Structures and Foundations for Vibrating Machines, Prentice Hall, 1981.
6. Major, A., Vibration Analysis and Design of Foundations for Machines and Turbines, Vol. I. II and IIIBudapest, 1964.
7. Barkan, D.D., Dynamics of Basis of Foundation, McGraw Hill, 1974.
8. Swami Saran, Soil Dynamics and Machine Foundation, Galgotia publications Pvt. Ltd. New Delhi 2010.
9. Das B.M., Principles of Soil Dynamics, McGraw Hill, 1992.
10. Krammer S.L., Geotechnical Earthquake Engineering, Prentice Hall, International series, PearsonEducation (Singapore) Pvt Ltd, 2004.

KameswaraRao, Vibration Analysis and Foundation Dynamics, Wheeler Publishing, New Delhi,

| 21CE1918 | ROCK MECHANICS | L | T | P | C |
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OBJECTIVES:

- Students are expected to classify, understand stress-strain characteristics, failure criteria, and influence ofin-situ stress in the stability of various structures and various technique to improve the in-situ strength of rocks.

UNIT I **CLASSIFICATION OF ROCKS** **9**

Types of Rocks - Index properties and classification of rock masses, competent and incompetent rock - value of RMR and ratings in field estimations.

UNIT II **STRENGTH CRITERIA OF ROCKS** **9**

Behaviour of rock under hydrostatic compression and deviatric loading - Modes of rock failure planes of weakness and joint characteristics - joint testing, Mohr - Coulomb failure criterion and tension cut- off. Hoek and Brown Strength criteria for rocks with discontinuity sets.

UNIT III **INSITU STRESSES IN ROCKS** **9**

In-situ stresses and their measurements, Hydraulic fracturing, flat jack, over coring and under coring methods -stress around underground excavations – Design aspects of openings in rocks.

UNIT IV **SLOPE STABILITY AND BEARING CAPACITY OF ROCKS** **9**

Rock slopes - role of discontinuities in slop failure, slope analysis and factor of safety - remedial measures forcritical slopes – Bearing capacity of foundations on rocks.

UNIT V **ROCK STABILIZATION** **9**

Stabilization of rocks-rock support and rock reinforcement-active and passive supports-ground response curve- support reaction curve-reinforcement of fractured and joined rocks-Shotcreting- bolting-anchoring-installation methods.

TOTAL : 45 PERIODS

**OUTCOMES:**

At the End of the Course, Learners will be able to:

1. Classify the Rock mass and rate the quality of rock for tunneling and foundations work and suggest the saferlength of tunneling and stand-up time.
2. Apply the knowledge of engineering and understand the stress – strain characteristics and failure criteria of rock and apply them to arrive at the shear strength parameters of rocks to be used for the design of structures resting on rock and also for the design of underground excavation in rocks.
3. Apply the knowledge of engineering and assess the influence of in-situ stress in the stability of various underground excavations and also acquire the knowledge of design of opening in rocks.
4. Apply the knowledge on rock mechanics and analyze the stability of rock slopes and arrive at the bearing capacity of shallow and deep foundations resting on rocks considering the presence of joints.
5. Improve the in-situ strength of rocks by various methods such as rock reinforcement and rock support. Able to select suitable support system considering the interaction between rock and support. Also capable of executing the same in the field.

**Reference Books:**

1. Goodman, R.E., Introduction to rock mechanics, John Willey and Sons, 1989.
2. Hudson, A. and Harrison, P., Engineering Rock mechanics – An introduction to the principles, Pergamonpublications, 1997.
3. Hoek, E and Bray, J., Rock slope Engineering, Institute of Mining and Metallurgy, U.K. 1981.
4. Hoek, E and Brown, E.T., Underground Excavations in Rock, Institute of Mining and Metallurgy, U.K.1981.
5. Obvert, L. and Duvall, W., Rock Mechanics and the Design of structures in Rock, John Wiley, 1967.
6. Bazant, Z.P., Mechanics of Geomaterials Rocks, Concrete and Soil, John Wiley and Sons, Chichester, 1985.Wittke, W., Rock Mechanics. Theory and Applications with case Histories, Springerverlag, Berlin, 1990.
7. Waltham, T, Foundations of Engineering Geology, Second Edition, Spon Press, Taylor & Francis Group, London and New York, 2002.
8. Ramamurthy T., "Engineering in Rocks for Slopes Foundations and Tunnels", PHI Learning Pvt. Ltd., 2007

| 21CE1919 | EARTH AND EARTH RETAINING STRUCTURES | L | T | P | C |
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OBJECTIVES:

- At the end of this course, students are expected to analyse and design rigid, flexible earth retainingstructures, slurry supported trenches and deep cuts.

UNIT I **EARTH PRESSURE THEORIES** **9**

Introduction – State of stress in retained soil mass – Earth pressure theories –Classical and graphical techniques(Culmann's method) – Active and passive cases – Earth pressure due to external loads.

UNIT II **COMPACTION, DRAINAGE AND STABILITY OF RETAINING STRUCTURES** **9**

Retaining structure – Selection of soil parameters - Lateral pressure due to compaction, strain softening, wall flexibility, drainage arrangements and its influence. – Stability analysis of retaining structure both for regular and earthquake forces

UNIT III **SHEET PILE WALLS** **9**

Types of sheet piles - Analysis and design of cantilever and anchored sheet pile walls – free earth support method –fixed earth support method. Design of anchor systems - isolated and continuous.

UNIT IV **SUPPORTED EXCAVATIONS** **9**

Lateral pressure on sheeting in braced excavation, stability against piping and bottom heaving. Earth pressure around tunnel lining, shaft and silos – Soil anchors – Soil pinning –Basic designconcepts.

UNIT V **SLURRY SUPPORTED EXACAVATION** **9**

Slurry supported trenches-basic principles-slurry characteristics-specifications-diaphragm walls- bored pile walls-contiguous pile wall-secant piles-stability analysis.

TOTAL : 45 PERIODS

**OUTCOMES:**

At the End of the Course, Learners will be able to:

1. Analyse the earth pressure acting on retaining structures by applying classical theories considering all influencing parameters and suggest the earth pressure to be considered for the design of retaining structures.
2. Apply the knowledge of engineering and earth pressure to analyse and design rigid retaining structures considering effect of compaction, wall flexibility, pore water pressure and earth quake forces.
3. Apply the knowledge of engineering and earth pressure to analyse and design flexible earth retaining walls andalso acquire the knowledge of design of anchors
4. Apply the knowledge on lateral earth pressure behind and around excavation to analyse and design braced excavations, slurry supported excavations and underground utilities.
5. To understand the role of slurry in supporting excavations and to perform stability analysis by considering the actual shape of slurry support

**Reference Books:**


1. Clayton, C.R.I., Militisky, J. and Woods, R.I., Earth pressure and Earth-Retaining structures, SecondEdition, Survey University Press, 1993.
2. Das, B.M., Principles of Geotechnical Engineering, Fourth Edition, The PWS

series in Civil Engineering,1998.

3. Militisky, J. and Woods, R., Earth and Earth retaining structures, Routledge,1992.
4. Winterkorn, H.F. and Fang, H.Y., Foundation Engineering Handbook, GalgotiaBooksource, 2000.
5. Rowe, R.K., Geotechnical and Geoenvironmental Engineering Handbook, Kluwer Academic Publishers,2001.
6. Koerner, R.M. Designing with Geosynthetics, Third Edition, Prentice Hall, 1997.
7. Day, R.W., Geotechnical and Foundation Engineering: Design and Construction, McGraw Hill, 1999.
8. Mandal, J.N., Reinforced Soil and Geotextiles, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi, 1993.
9. McCarthy, D.F., Essentials of Soil Mechanics and Foundations: Basic Geotechnics, Sixth Edition, PrenticeHall, 2002.
10. Hajnal, I., Marton, J. and Regele, Z., Construction of diaphragm walls, A Wiley – InterscicencePublication, 1984.
11. Petros P. Xanthakos., Slurry walls as structural systems, McGraw-Hill, Inc., New York, 1994.
12. Bramhead, E.N., The Stability of Slopes, Blacky Academic and Professionals Publications, Glasgow,1986.
13. Muni Budhu, Soil Mechanics and Foundation, John Wiley and Sons, INC 2007.

| 21CE1920 | PILE FOUNDATION | L | T | P | C |
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OBJECTIVES:

- The student will be exposed to the design of piles, pile groups and caissons with respect to vertical and lateral loads for various field conditions**.**

UNIT I **PILE CLASSIFICATIONS AND LOAD TRANSFER PRINCIPLE** **9**

Necessity of pile foundation – classification of piles – Factors governing choice of type of pile – Load transfer mechanism – piling equipment's and methods – effect of pile installation on soil condition – pile raft system – basic interactive analysis - criteria for pile socketing.

UNIT II **AXIAL LOAD CAPACITY OF PILES AND PILE GROUPS** **9**

Allowable load of piles and pile groups – Static and dynamic methods – for cohesive and cohesionless soil – negative skin friction – group efficiency – pile driving formulae - limitation – Wave equation application – evaluation of axial load capacity from field test results - Settlement of piles and pile group.

UNIT III **LATERAL AND UPLIFT LOAD CAPACITIES OF PILES** **9**

Piles under Lateral loads – Broms method, elastic, p-y curve analyses – Batter piles – response to moment – pilesunder uplift loads – under reamed piles – Drilled shaft – Lateral and pull out capacity from load test.

UNIT IV **STRUCTURAL DESIGN OF PILE AND PILE GROUPS** **9**

Structural design of pile – structural capacity – pile and pile cap connection – pile cap design – shape, depth, assessment and amount of steel – truss and bending theory- Reinforcement details of pile and pile caps — pile subjected to vibration.

UNIT V **CAISSONS** **9**

Necessity of caisson – type and shape - Stability of caissons – principles of analysis and design – tilting of caisson –construction - seismic influences.

TOTAL : 45 PERIODS

**OUTCOMES:**

At the End of the Course, Learners will be able to:

1. Explain the importance of pile foundation and various functions and responsibilities of geotechnical engineer andcontractor, in addition to the piling equipments.
2. Determine the vertical load carrying capacity of pile and pile group- keeping the settlement of pile as animportant criteria based on field practices and codal provisions.
3. Apart from vertically loaded piles, the structures are exposed to the peculiar pile subjected to lateral and upliftload with reference to codal provision and case studies.
4. Understand the design of pile and pile caps, considering the wind and seismic loads.
5. Explain the importance of caisson foundation and checking the stability of caissons based on codal provisions.

**Reference Books:**

1. Das, B.M., Principles of Foundation Engineering, Design and Construction, Fourth Edition, PWSPublishing, 1999.

2. Poulos, H.G., Davis, E.H., Pile foundation analysis and design, John Wiley and Sons, New York, 1980.
3. Tomlinson, M.J. Foundation engineering, ELBS, Longman Group, U.K. Ltd., England 1995.
4. Michael Tomlinson and John Woodward, Pile design and construction practice, Taylor & Francis Group,London & New York, 2008.
5. Cernica, J.N. Geotechnical Engineering Foundation Design, John Wiley and Sons, Inc. 1995.
6. Bowles, J.E., Foundation Analysis and Design, Fifth Edition, McGraw Hill, New York, 1996.
7. Donald, P., Coduto, Foundation Design Principles and Practices, Prentice Hall, Inc. Englewood Cliffs,New Jersey, 1996.
8. Varghese P.C.," Foundation Engineering", PHI Learning Private Limited, New Delhi, 2005.
9. Reese,L.C., Isenhower,W.M. and Wang,S.T. Analysis and Design of Shallow and Deep Foundations, JohnWiley and Sons, New York, 2005.
10. Varghese P.C.," Design of Reinforced Concrete Foundations", PHI Learning Private Limited, New Delhi,2009.
11. Reese, L. C. and Van Impe, W. F., Single Piles and Pile Groups Under Lateral Loading, Taylor andFrancis, London, 2011.

| 21CE1921 | TUNNELING ENGINEERING | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

OBJECTIVES:

- Students mainly focused in visualizing and critically analyzing the behavior of underground structures with reference to various supporting systems under different loading conditions dueto induced earth pressure on the underground structures.
- To give idea about the equipment used in underground excavations

UNIT I **TUNNELS AND UNDERGROUND SPACE APPLICATION** **9**

History-caves-tunnels for transport-water, power supply-storage of LPG –nuclear waste disposal-defence facilities-submerged tunnels-underground library, museums.

UNIT II **EXCAVATION TECHNIQUES** **9**

Types and purpose of tunnels-choice of excavation methods-soft ground tunneling-hard rock tunneling- tunnel drilling-blasting-impact hammers-problems encountered and remedial measures.

UNIT III **PLANNING AND GEOMETRIC DESIGN OF TUNNELS** **9**

Topographical –geological survey-rock sampling-testing-determination of location size shape and alignment-subsidence problem on soft ground –tunneling design in hard rock.

UNIT IV **CONSTRUCTION OF TUNNEL** **9**

Advanced drilling techniques –TBM-cuttability assessment-shield tunneling-advantages-types of shield tunneling-factors affecting selection of shield-twin tunnel-NATM.

UNIT V **DESIGN OF TUNNEL SUPPORTING SYSTEMS AND VENTILATION** **9**

Classification of supports-active –passive-permanent-temporary-excavation support-steel supports-lining-grouting-ground freezing-environment in underground-various methods of ventilation.

TOTAL : 45 PERIODS

**OUTCOMES:**

At the End of the Course, Learners will be able to:

1. To understand need of utilization of underground space for various applications.
2. To study various methods of excavations and tunneling methods.
3. Planning and design process of tunnels.
4. To identify the suitable method of tunneling.
5. To study various types of support system and its merit and demerits.

**Reference Books:**


1. Underground infrastructure planning design construction-R.K.Goel, Bhavani singh, JianZhao, Butterworth heinemunn publishers.
2. Practical tunnel construction, Hemphill G.B 2012 Johnwileyand Son.
3. Introduction to tunnel construction, David chapran, Nicole metse and Alfred stark,Spor press.

## VERTICAL IV: GEO-INFORMATICS

| 21CE1922 | TOTAL STATION AND GPS SURVEYING | L | T | P | C |
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OBJECTIVES:

- To understand the working of Total Station and GPS and solve the surveying problems.

UNIT I **FUNDAMENTALS OF TOTAL STATION AND ELECTROMAGNETIC WAVES** **9**

Methods of Measuring Distance, Basic Principles of Total Station, Historical Development, Classifications, applications and comparison with conventional surveying - Applications of Electromagnetic waves, Propagation properties, wave propagation at lower and higher frequencies – Refractive index (RI) – factors affecting RI -Computation of group for light and near infrared waves at standard and ambient conditions – Computation of RI for microwaves at ambient condition – Reference refractive index -Real-time application of first velocity correction. Measurement of atmospheric parameters - Mean refractive index – Second velocity correction -Total atmospheric correction - Use of temperature -pressure, transducers**.**

UNIT II **ELECTRO-OPTICAL AND MICROWAVE** **9**

Electro - optical system: Measuring principle, Working principle, Sources of Error, Infrared and Laser Total Station instruments. Microwave system: Measuring principle, working principle, Sources of Error, Microwave Total Station instruments. Comparison between Electro-optical and Microwave system. Care and maintenanceof Total Station instruments. COGO functions: Area, Inverse / MLM, REM, Resection, offsets and stakeout - Land survey applications.

UNIT III **SATELLITE SYSTEM** **9**

Basic concepts of GPS – Historical perspective and development – applications -Geoid and Ellipsoid satellite orbital motion – Keplerian motion – Kepler's Law – Perturbing forces - Geodetic satellite – Doppler effect – Positioning concept – GNSS and IRNSS – SBAS: GAGAN and WAAS Different segments - space, control and user segments – satellite configuration – GPS signal structure – Orbit determination and representation –Anti Spoofing and Selective Availability -Task of control segment GPS receivers.

UNIT IV **GPS DATA PROCESSING** **9**

GPS observables – code and carrier phase observation – linear combination and derived observables concept of parameter estimation – downloading the data – RINEX Format– Differential data processing – software modules - solutions of cycle slips, ambiguities - Multi path and other observational errors – satellite geometryand accuracy measures – Continuously Operating Reference System (CORS)– long base line processing - useof different processing software's: Open Source, Scientific and Commercial.

UNIT V **SURVEYING METHODS AND APPLICATIONS** **9**

Total Station: Traversing and Trilateration measurement and adjustment –Planimetric map and Contour mapand Topography Mapping.GNSS: Concepts of rapid, static, semi-Kinematic, pure Kinematic and RTK methods. Observation by Radiation, Lee frog and Trilateration measurement and processing -Topography mapping using PPK and RTK methods Total Station and GNSS applications

TOTAL : 45 PERIODS

**OUTCOMES:**

At the End of the Course, Learners will be able to:

1. Learn about the fundamental concept of Total station.

2. Provide knowledge about electromagnetic waves and its usage in Total station and GNSS.
3. Gain Knowledge on basic concepts of GNSS
4. Understand the measuring and working principle of electro optical and Microwave Total stationand GPS
5. Gain knowledge about Total station and GNSS data processing and Mapping.

Text Books:


1. Rueger, J.M. Electronic Distance Measurement, Springer-Verlag, Berlin, 4th Edition,1996.
2. Satheesh Gopi, R A sathishkumar, N.madhu, — Advanced Surveying , Total Station GPS and Remote Sensing — Pearson education , 2nd Edition,2017. ISBN: 978-81317 00679.
3. Gunter Seeber , Satellite Geodesy, Walter De Gruyter, Berlin, 2nd Edition, 2003


**Reference Books:**


1. R.Subramanian, Surveying and Levelling, Oxford University Press, Second Edition, 2012.
2. Laurila, S.H. Electronic Surveying in Practice, John Wiley and Sons Inc, 1983
3. Guocheng Xu, GPS Theory, Algorithms and Applications, Springer - Verlag, Berlin, 3rdEdition,2016.
5. Alfred Leick, GPS satellite surveying, John Wiley & Sons Inc., 4th Edition, 2015.

| 21CE1923 | REMOTE SENSING CONCEPTS | L | T | P | C |
|---|---|---|---|---|---|
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OBJECTIVES:

- To introduce the concepts of remote sensing processes and its components.
- To expose the various remote sensing platforms and sensors and to introduce the elements of datainterpretation

UNIT I **REMOTE SENSING AND ELECTROMAGNETIC RADIATION** **9**

Definition – components of RS – History of Remote Sensing – Merits and demerits of data collation between conventional and remote sensing methods - Electromagnetic Spectrum – Radiation principles - Wave theory, Planck's law, Wien's Displacement Law, Stefan's Boltzmann law, Kirchoff's law-Radiation sources: active & passive - Radiation Quantities

UNIT II **EMR INTERACTION WITH ATMOSPHERE AND EARTH MATERIAL** **9**

Standard atmospheric profile – main atmospheric regions and its characteristics – interaction of radiation with atmosphere – Scattering, absorption and refraction – Atmospheric windows - Energy balance equation – Specular and diffuse reflectors – Spectral reflectance & emittance – Spectroradiometer – Spectral Signature concepts – Typical spectral reflectance curves for vegetation, soil and water – solid surface scattering in microwave region.

UNIT III **ORBITS AND PLATFORMS** **9**

Motions of planets and satellites – Newton's law of gravitation - Gravitational field and potential - Escape velocity - Kepler's law of planetary motion - Orbit elements and types – Orbital perturbations and maneuvers – Types of remote sensing platforms - Ground based, Airborne platforms and Space borne platforms – Classification of satellites – Sun synchronous and Geosynchronous satellites – Legrange Orbit.

UNIT IV **SENSING TECHNIQUES** **9**

Classification of remote sensors – Resolution concept : spatial, spectral, radiometric and temporal resolutions - Scanners - Along and across track scanners – Optical-infrared sensors – Thermal sensors – microwave sensors – Calibration of sensors - High Resolution Sensors - LIDAR , UAV- Orbital and sensor characteristics of live Indian earth observation satellites

UNIT V **DATA PRODUCTS AND INTERPRETATION** **9**

Photographic and digital products – Types, levels and open source satellite data products –- selection and procurement of data– Visual interpretation: basic elements and interpretation keys -Digital interpretation – Concepts of Image rectification, Image enhancement and Image classification

TOTAL : 45 PERIODS

**OUTCOMES:**

At the End of the Course, Learners will be able to:

1. Understand the concepts and laws related to remote sensing.
2. Understand the interaction of electromagnetic radiation with atmosphere and earth material
3. Acquire knowledge about satellite orbits and different types of satellites
4. Understand the different types of remote sensors
5. Gain knowledge about the concepts of interpretation of satellite imagery.

Text Books:

1. Thomas M.Lillesand, Ralph W. Kiefer and Jonathan W. Chipman,

Remote Sensing andImageinterpretation, John Wiley and Sons, Inc, New York,2015.
2. George Joseph and C Jeganathan, Fundamentals of Remote Sensing,Third EditionUniversities Press (India) Private limited, Hyderabad, 2018

**Reference Books:**

1. Janza, F.Z., Blue H.M. and Johnson,J.E. Manual of Remote Sensing. Vol.I, AmericanSociety ofPhotogrametry, Virginia, USA, 2002.
2. Verbyla, David, Satellite Remote Sensing of Natural Resources. CRC Press, 1995
3. Paul Curran P.J. Principles of Remote Sensing. Longman, RLBS, 1988.
4. Introduction to Physics and Techniques of Remote Sensing , Charles Elachi and JacobVan Zyl,2006Edition II, Wiley Publication.
5. Basudeb Bhatta, Remote Sensing and GIS, Oxford University Press, 2011

| 21CE1924 | SATELLITE IMAGE PROCESSING | L | T | P | C |
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OBJECTIVES:

- To make the undergraduate Engineering Students understand the concepts, principles,processing of Satellite data in order to extract useful information from them.

UNIT I **FUNDAMENTALS OF IMAGE PROCESSING** **9**

Information Systems - Encoding and decoding - acquisition, storage and retrieval –data products - satellite data formats - Digital Image Processing Systems - Hardware and software design consideration Scanner, digitizer - photo write systems.

UNIT II **SENSORS MODEL AND PRE PROCESSING** **9**

Image Fundamentals – Sensor models – spectral response – Spatial response – IFOV,GIFOV& GSI – Simplified Sensor Models – Sampling & quantization concepts – Image Representation& geometry and Radiometry – Colour concepts – Sources of Image degradation and Correction procedures- Atmospheric, Radiometric, Geometric Corrections- Image Geometry Restoration- Interpolation methods and resampling techniques.

UNIT III **IMAGE ENHANCEMENT** **9**

Image Characteristics - Histograms - Scattergrams – Univariate and multi variate statistics- enhancement in spatial domain – global, local & colour Transformations – PC analysis, edge detections, merging - filters - convolution – LPF, HPF , HBF, directional box, cascade – Morphological and adaptive filters – Zero crossing filters – scale space transforms – power spectrum – texture analysis – frequency transformations - Fourier, wavelet and curvelet transformations.

UNIT IV **IMAGE CLASSIFICATION** **9**

Spectral discrimination - pattern recognition concepts - Baye‘s approach - Signature and training sets – Separability test –Supervised Classification – Minimum distance to mean, Parallelepiped, MLC – Unsupervised classifiers – ISODATA,K-means-Support Vector Machine – Segmentation (Spatial, Spectral) – Tree classifiers - Accuracy assessment – Error matrix – Kappa statistics –ERGAS, RMS.

UNIT V **ADVANCED CLASSIFIERS** **9**

Fuzzy set classification – sub- pixel classifier – hybrid classifiers, Texture based classification –Object based classifiers – Artificial Neural nets – Hebbian leaning – Expert system, types and examples – Knowledge systems.

TOTAL : 45 PERIODS

**OUTCOMES:**

At the End of the Course, Learners will be able to:

1. Understand about Remote sensing and Image processing systems
2. Acquire knowledge about the source of error in satellite image and also to remove the error fromsatellite image.
3. Select appropriate image Enhancement techniques based on image characteristics
4. Classify the satellite image using various method and also evaluate the accuracy of classification.
5. Apply the advanced image classification methods and conduct lifelong research in the field of imageprocessing.

Text Books:

1. John, R. Jensen, Introductory Digital Image Processing, Prentice Hall, New Jersey, 4thEdition, 2015.

2. Robert, A. Schowengergt, Techniques for Image Processing and classification in Remote Sensing,Academic Press, 2012.

**Reference Books:**

1. Robert, G. Reeves,- Manual of Remote Sensing Vol. I & II - American Society ofPhotogrammetry, Falls, Church, USA, 1983.
2. Richards, Remote sensing digital Image Analysis - An Introduction 5th Edition ,2012,Springer-Verlag 1993.
3. Digital Image Processing by Rafael C. Gonzalez, Richard Eugene Woods-Pearson/PrenticeHall,2008
4. Fundamentals of Digital Image Processing by Annadurai Pearson Education (2006)
5. Digital Image Processing: PIKS Scientific Inside by William K. Pratt 4th Edition, WileyInterscience,2007.

| 21CE1925 | CARTOGRAPHY AND GIS | L | T | P | C |
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OBJECTIVES:

- To introduce concepts of Cartography and GIS
- To expose the process of map making and production
- To introduce GIS data structures, data input and data presentation.

UNIT I **ELEMENTS OF CARTOGRAPHY** **9**

Definition of Cartography – Maps – Functions – Uses and Types of Maps – Map Scales and Contents- Map Projections – Shape, Distance, Area and Direction Properties – Perspective and mathematical Projections – IndianMaps and Projections – Map Co-ordinate System – UTM and UPS References.

UNIT II **MAP DESIGN AND PRODUCTION** **9**

Elements of a Map – Map Layout Principles – Map Design Fundamentals – Symbols and Conventional Signs – Graded and Ungraded Symbols – Color Theory – Colours and Patterns in Symbolization – Map Lettering – Map Production – Map Printing – Colours and Visualization – Map Reproduction – Map Generalization – Geometric Transformations – Bilinear and Affine Transformations.

UNIT III **FUNDAMENTALS OF GIS** **9**

Introduction to GIS – Definitions – History of GIS – Components of a GIS – Hardware, Software, Data, People, Methods – Introduction to data quality – Types of data – Spatial, Attribute data – types of attributes – scales/levels of measurements – spatial data models – Raster Data Structures – Raster Data Compression – Vector Data Structures – Raster Vs Vector Models – TIN and GRID data models

UNIT IV **DATA INPUT AND TOPOLOGY** **9**

Scanner – Raster Data Input – Raster Data File Formats – Geo referencing– Vector Data Input – Digitizer– Datum Projection and Reprojection – Coordinate Transformation – Topology - Adjacency, Connectivity and containment – Topological Consistency – Non topological file formats – Attribute Data Linking – Linking External Databases – GPS Data Integration – Raster to Vector and Vector to Raster Conversion.

UNIT V **DATA QUALITY AND OUTPUT** **9**

Assessment of Data Quality - Basic Aspects - Completeness, Logical Consistency, Positional Accuracy, Temporal Accuracy, Thematic Accuracy and Lineage – Metadata – GIS Standards – Interoperability – OGC - Spatial Data Infrastructure – Data Output – Map Compilation – Chart / Graphs.

TOTAL : 45 PERIODS

**OUTCOMES:**

At the End of the Course, Learners will be able to:

1. Be familiar with appropriate map projection and co-ordinate system for production of Maps andshall able to compile and design maps for their required purpose.
2. Be familiar with co-ordinate and Datum transformations Learn about the fundamental concept of Total station.
3. Understand the basic concepts and components of GIS, the techniques used for storage of spatialdata and data compression
4. Understand the concepts of spatial data quality and data standard
5. Understand the concept of spatial data inputs

Text Books:


1. Arthur H. Robinson et al, "Elements of Cartography", 7th Edition, Wiley, 2002.
2. Kang – Tsung Chang, "Introduction to Geographic Information Systems", McGraw HillPublishing, Fourth Edition, 2017.
3. Ian Heywood, Sarah Cornelius, Steve Carver, Srinivasa Raju, "An Introduction to Geographical Information Systems, Pearson Education, Fourth Edition, 2011.


**Reference Books:**


1. John Campbell, "Introductory Cartography", Wm. C.BrownPublishers,3rd Edition,2004
2. Chor Pang LO, Albert K. W. Yeung, "Concepts and Techniques of Geographic Information Systems", PearsonEducation, 2nd Edition, November 2016. ISBN: 9789332581883


| 21CE1926 | PHOTOGRAMMETRY | L | T | P | C |
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OBJECTIVES:

- To introduce basics and concepts of optics, aerial photography acquisition and mapping fromaerialphotographs.

UNIT I **PRINCIPLES AND PROPERTIES OF PHOTOGRAPHY** **9**

History - Definition, Applications – Types of Photographs, Classification – Photographic overlaps – Camera: metric vs. non-metric, Digital Aerial cameras – Multiple frame and Line cameras – Linear array scanner – Flight Planning – Crab & Drift– Computation of flight plan - Photogrammetry project Planning.

UNIT II **GEOMETRIC PROPERTIES OF AERIAL PHOTOGRAPHS** **9**

Photo coordinate measurement – Vertical photographs -geometry, scale, Coordinate system, Relief displacement – Stereoscopes – Stereoscopic parallax – parallax equations -Geometry, Scale, Coordinate system – Relief displacement –- Photo Interpretation.

UNIT III **STEREOPLOTTERS & ORIENTATION** **9**

Projection system, Viewing, Measuring and Tracing system Stereo plotters–Classification: Analog, semi analytical, Analytical and Digital systems – Interior orientation - Relative orientation – Absolute orientation - Collinearity condition and Coplanarity condition - Orientation: Two-dimensional coordinate transformations –Three-dimensional conformal coordinate transformation

UNIT IV **AEROTRIANGULATION, TERRAIN MODELING, ORTHOPHOTO** **9**

Model – Strip and blocks of photographs – Aero triangulation: strip adjustment, independent model triangulation, Bundle block Adjustment and GPS Aero triangulation (INS and GNSS integration) - feature collection – DTM generation and Contour mapping – ortho rectification - mono plotting – stereo plotting

UNIT V **DIGITAL PHOTOGRAMMETRY** **9**

Photogrammetric Scanner – Digital Photogrammetry WorkStation – Work Station Basic system function– Storage System – Stereoscopic Viewing and Measuring System – Image properties - Image matching: template matching, feature based matching - DEM and DSM - Satellite photogrammetry principles

TOTAL : 45 PERIODS

**OUTCOMES:**

At the End of the Course, Learners will be able to:

1. Understand and appreciate the importance of photography as means of mapping, functional andphysical elements of photography.
2. Understand the need of the photogrammetric mapping and the relevance of accuracy standards and means to achieve them for precise large-scale maps with scientific methods.
3. Evaluate the standards of map based on the state-of-the-art tool and techniques and assess theproduction standards for photogrammetric map making.
4. Acquire knowledge on the current development, issues methods and solutions in map making and evaluate methods of production.
5. Analyze critically and evaluate methods by applying the knowledge gained and to be a part of innovation and integration of mapping technology.

Text Books:


1. Paul. R Wolf., Bon A. De Witt, Elements of Photogrammetry with Application in GIS McGraw Hill International Book Co., 4thEdition, 2014.
2. E. M. Mikhail, J. S. Bethel, J. C. McGlone, Introduction to Modern Photogrammetry, WileyPublisher, 2001.


**Reference Books:**


1. Gollfried Konecny, Geo information: Remote Sensing, Photogrammetry and Geographical InformationSystems, CRC Press, 2nd Edition, 2014.
2. Karl Kraus, Photogrammetry: Geometry from Images and Laser Scans, Walter de Gruyter GmbH& Co.2ndEdition, 2007.
3. Manual of Photogrammetry – American society of Photogrammetry & amp; R. S by Albert. D,1980.
4. Digital Photogrammetry – A practical course by Wilfried Linder, 3rd edition, Springer, 2009.
5. Digital Photogrammetry by – Y. Egels& amp; Michel Kasser, Taylor & amp; Francis group,2003.

| 21CE1927 | HYDROGRAPHIC SURVEYING | L | T | P | C |
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OBJECTIVES:

- To provide the necessary knowledge and practical instrument operational and data processing skillsneeded for them to confidently accomplish a bathymetric survey in the real world
- To develop students' critical and creative thinking, as well as cooperative attitudes & behavior ofworking with others.

UNIT I **INTRODUCTION, TIDES AND DATUMS** **9**

Overview of hydrographic surveying concepts- bathymetric and nautical charts- Basic tidal theory- tidal observations and predictions - common types of recording tide gauges - different vertical datums - Indian tides

UNIT II **SOUNDINGS** **9**

Overview of depth data types- Working principle of echo sounders - characteristics and nature of underwater acoustic signals – transducers - error sources and calibrations- Advanced instrumentation.

UNIT III **NAVIGATION AND POSITION FIXING** **9**

Horizontal positioning methods and requirements - concept of line and surface of position - positioning and navigation using satellite positioning systems - differential GPS and Real-time kinematic (RTK)

UNIT IV **PLANNING AND DATA PROCESSING** **9**

General considerations for planning of an inshore hydrographic survey - ground and track control - practical soundings in inshore and coastal surveys - data processing and chart compilation - hydrographic software packages for data collection - processing and plotting.

UNIT V **MARINE ENVIRONMENTAL MEASUREMENTS** **9**

Methods of measuring and recording of currents - composition of the sea bed - and solids in suspension - Case Studies (The role of the hydrographic surveyor on different marine projects)

TOTAL : 45 PERIODS

**OUTCOMES:**

At the End of the Course, Learners will be able to:

1. Learn the fundamentals of hydrographic surveying
2. Identify the appropriate techniques for different types of survey
3. Understand the various options available during the Navigation
4. Analyze the data collected from a survey and assess its quality against the project requirements.
5. Discuss the different roles for a hydrographic surveyor on marine projects

Text Books:

1. U.S. Army Corps of Engineers, (2002), Hydrographic Surveying, Document No. EM 1110-2-1003.

**Reference Books:**

1. De Jong, C. D., Lachapelle, G., Skone, S. & Elema, I. A. (2002), Hydrography, Delft University Press,The Netherlands.
2. Ingham, A. E. (1992), Hydrography for the Surveyor and Engineer, 3rd Edition revised by Abbott
**V.** J., Blackwell Science.
3. International Hydrographic Organisation (1998), IHO Standards for

Hydrographic Surveying (S-44),IHB Monaco.
4. Loweth, R. P. (1997), Manual of Offshore Surveying for Geoscientists and Engineers Chapman& Hall.
5. Pugh, D. (2004), Changing Sea Levels – Effects of Tides, Weather and Climate, CambridgeUniversity Press.
6. Sonnenberg, G. J. (1988), Radar and Electronic Navigation, Butterworths.

| 21CE1928 | AIRBORNE AND TERRESTRIAL LASER MAPPING | L | T | P | C |
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OBJECTIVES:

- To introduce the concepts of Space Borne, Air Borne, Terrestrial and Bathymetric LASERScanners for Topographic and Bathymetric Mapping

UNIT I **SPACE BORNE RADAR AND LIDAR ALTIMETER 9**

Principle and Properties of LASER- Production of Laser – Components of LASER – LiDAR – Typesof LiDAR: Range Finder, DIAL and Doppler LiDAR - Platforms: Terrestrial, Airborne and Space borneLiDAR – Space Borne LiDAR Missions – Space Borne Radar Altimeter for mapping Sea SurfaceTopography , Moon Topography - Merits of ALS in comparison to Levelling, echo sounding, GPSleveling, Photogrammetry and Interferometry

UNIT II **AIRBORNE LASER SCANNERS 9**

Airborne Topographic Laser Scanner – Ranging Principle – Pulse Laser and Continuous Wave Laser–First Return and Last Return – Ellipsoidal and Geoidal Height - Typical parameters of Airborne Laser Scanner (ALS) – Specifications of Commercial ALS –- Components of ALS - GPS, IMU, LASER Scanner, Imaging Device, Hardware and Software - Various Scanning Mechanisms: Oscillating Mirror, Rotating Polygon, Nutating Mirror, Fibre Optic

UNIT III **DATA ACQUISITION AND PRE-PROCESSING 9**

Laser Classification – Class I to Class IV Laser – Eye Safety - Synchronization of GPS, IMU and ALS Data -Reflectivity of terrain objects –- Flight Planning – Determination of various data acquisitionparameters – Swath Width, Point Density, No. of Strips, Area Covered, Point Spacing - Data Processing – Determination of optimal flight trajectory- Quality Assurance

UNIT IV **POST PROCESSING of LiDAR Data 9**

Post Processing – Geo location of Laser Foot Prints – Various Co-ordinate Transformations involvedFiltering - Ground Point filtering – Digital Surface Model and Digital Elevation Model - LIDAR datafile formats – LAS File format and other proprietary file formats – Post Processing Software: OpenSource and COTS Software – Quality Control Measures – Error Budget - Overview of LIDAR Applications in various domains - 3D city models – Corridor Mapping Applications – Forestry Applications.

UNIT V **TERRESTRIAL LASER SCANNERS 9**

Terrestrial Laser Scanners (TLS) – Working Principle – Static TLS – Dynamic TLS –- CommercialTLS Specifications – Mobile Mapping Lasers :Vehicle Mounted TLS, Back Pack Wearable LaserScanners – Asset Management Studies – Highways and Railway Asset Management – Indoor Mapping : Laser Scanning of interior of buildings/monuments – Immersive Applications - BIM Model-Applications in Tunnel Surveying, Forest Inventory, Open Cast Mine Surveying

TOTAL : 45 PERIODS

**OUTCOMES:**

At the End of the Course, Learners will be able to:

1. Understand the components of laser and various platforms of laser scanning
2. Summarize the components of Airborne Laser Scanner and concept of ranging principles
3. Analyse the flight planning parameters and pre-processing of acquired data
4. Post process the data to derive DSM and DEM and its applications
5. Understand the components of TLS and its applications

**Text Books:**


1. Jie Shan, Charles K. Toth, "Topographic Laser Ranging and Scanning – Principles andProcessing", 2nd Edition, CRC Press Publication, March 2018. ISBN: 9781498772273.


**Reference Books:**


1. George Vosselman and Hans-Gerd Maas, Airborne and Terrestrial Laser Scanning,Whittles Publishing, 2010
2. Matti Maltamo, Erik Næsset, Jari Vauhkonen, Forestry Applications of Airborne Laser Scanning-Concepts and Case Studies, Springer, Dordrecht , 2016,Reprint Edition. ISBN 978-94-017-8662-1
3. Michael Renslow, Manual of Airborne Topographic LiDAR, The American Society for Photogrammetry and Remote Sensing, 2013

## VERTICAL - V TRANSPORTATION INFRASTRUCTURE

| 21CE1929 | TRAFFIC ENGINEERING AND MANAGEMENT | L | T | P | C |
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OBJECTIVES:

- To introduce the students about airport planning, design, construction and planning design principles of seaport.

UNIT I **AIRPORT PLANNING** **7**

Air transport characteristics - airport classification – ICAO - airport planning: Site selection typical Airport Layouts, Case Studies, parking and Circulation Area.

UNIT II **AIRPORT COMPONENTS** **9**

Airport Classification, Planning of Airfield Components – Runway, Taxiway, Apron, Hangar-Passenger Terminals- Geometric design of runway and taxiways-Runway pavement Design-Difference between Highway and airport pavements- Introduction to various design methods-Airport drainage.

UNIT III **AIRPORT DESIGN** **10**

Runway Design: Orientation, Wind Rose Diagram, Problems on basic and Actual Length, Geometric Design – Elements of Runway Design – Airport Zones – Passenger Facilities and Services – Runway and Taxiway Markings- Air Traffic Control Tower- Instrumental Landing.

UNIT IV **SEAPORTS COMPONENTS AND CONSTRUCTION** **10**

Definition of Basic Terms: Harbor, Port, Satellite Port, Docks- Dry and Floating Dock, Waves and Tides – Planning and Design of Harbors: Harbour Layout and Terminal Facilities – Coastal Structures: Piers, Break waters, Wharves, Jetties, Quays, Spring Fenders, Dolphins Floating Landing Stage – Navigational Aids-Inland Water Transport.

UNIT V **SEAPORT REGULATIONS AND EIA** **9**

Wave action on Coastal Structures and Shore Protection and Reclamation – Coastal Regulation Zone,2011- EIA – methods of impact analysis and its process.

TOTAL : 45 PERIODS

**OUTCOMES:**

On completion of the course, the student is expected to

1. Gain an insight on the planning and site selection of Airport Planning and design.
2. Knowledge on Design of various Airport components
3. Analyze and design the elements for orientation of runways and passenger facility systems.
4. Understand the various features in Harbours and Ports, their construction, coastal protection works
5. Knowledge on various Environmental Regulations and Acts

**TEXT BOOKS:**


1. Khanna.S.K. Arora.M.G and Jain.S.S, Airport Planning and Design, Nemachand and Bros, Roorkee,1994
2. Robert Honjeff and Francis X.Mckelvey, "Planning and Design of Airports", McGraw Hill, New York,1996 2. Richard De Neufille and Amedeo Odoni, "Airport Systems Planning and Design", McGraw Hill, New York,2003
3. Subramanian K.P., Highways, Railways, Airport and Harbour Engineering,Scitech Publications(India), Chennai, 2010

| 21CE1930 | URBAN PLANNING AND DEVELOPMENT | L | T | P | C |
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OBJECTIVES:

- To enable students to have the knowledge on planning process and to introduce to the students about the regulations and laws related to Urban Planning.

UNIT I **INTRODUCTION** **7**

. Definition of Human settlement, Urban area, Town, City, Metropolitan City, Megalopolis, Urbanisation, Urbanism, Suburbanisation, Urban sprawl, Peri-urban areas, Central Business District (CBD), Urban Agglomeration, Census definition of urban settlements, Classification of urban areas –Positive and negative impacts of urbanisation, - Atal Mission for Rejuvenation and Urban Transformation (AMRUT).

UNIT II **PLANNING PROCESS AND THEORIES** **10**

Principles of Planning –Stages in Planning Process – Goals, Objectives, Delineation of Planning Areas, Draft Plans, Evaluation, Final Plan. Planning Theories - Garden City Concept, Geddesian Triad by Patrick Geddes, Modernism Concept by Le-Corbusier, Radbun Concept, Neighbourhoods, Theories of Ekistics, Bid- rent Theory by William Alonso, Green Belt Concept.

UNIT III **DEVELOPMENT PLANS, PLAN FORMULATION AND EVALUATION** **10**

Types of plans – Regional Plan, Master Plan, Structure Plan, Detailed Development Plan, New Town/ Satellite town- Development Plan, urban nodes, Smart City Plan -Scope and Content of Regional Plan (RP), Master Plan (MP), and the Detailed Development Plan (DDP), Methodologies for the preparation of the RP, MP, and the DDP – Case Studies.

UNIT IV **PLAN IMPLEMENTATION** **10**

Planning Standards, Project Formulation and evaluation; Project Report preparation and presentation; Legal, Financial and Institutional constraints – Problems due to multiple laws, rules and institutions; Financing of Urban Development Projects; Urban planning agencies and their functions in the plan formulation and implementation.

UNIT V **URBAN AND REGIONAL PLANNING LEGISLATIONS, REGULATIONS AND DESIGNS** **8**

Town and Country Planning, Local Bodies and Land Acquisition Acts, Development and Building Rules, Site analyses, Layouts and Buildings Design.

TOTAL : 45 PERIODS

**OUTCOMES:**

Students will be able to

1. Understand the basic issues and meaning of terminologies in urban planning
2. Understand the different types of theories of urban planning and city development.
3. Understand the different types of plan, their strategies and their preparation process.
4. Comprehend the planning standards, evaluate the constraints and the financial mechanism
5. Knowledge on various town and country planning acts and their functions.

**REFERENCE BOOKS:**


1. Goel, S.L Urban Development and Management, Deep and Deep publications, New Delhi 2002
2. George Chadwick, A Systems view of planning, Pergamon press, Oxford 1978
3. Singh V.B, Revitalised Urban Administration in India, Kalpaz publication, Delhi, 2001.

4. Edwin S.Mills and Charles M.Becker, Studies in Urban development, A World Bank publication,1986.

**REFERENCES**


1. Tamil Nadu Town and Country Planning Act 1971, and Rules made thereunder, Government ofTamil Nadu, Chennai
2. Thooyavan, K.R., Human Settlements – A Planning Guide to Beginners, M.A Publications, Chennai, 2005.
3. Chennai City Municipal Corporation Act, 1919 and Tamil Nadu District Municipalities Act, 1920.
4. The Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013.
5. The Tamil Nadu Combined Development and Building Rules, 2019.
6. Urban & Regional Development Plans Formulation & Implementation (URDPFI) Guidelines, VolI & II, Jan 2015, Govt of India, Ministry of Urban Development
7. http:/.moud.gov.in .

| 21CE1931 | SMART CITIES | L | T | P | C |
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OBJECTIVES:

- To help the learners to understand the concepts of smart city and to introduce the students about application of technologies in smart cities

UNIT I **INTRODUCTION** **6**

Urbanisation, need of focused development, role of Authorities, Smart city, Opportunity and Challenges- Smart infrastructures for city- Smart Cities Mission.

UNIT II **SMART PHYSICAL INFRASTRUCTURE** **12**

Infrastructure development in Smart Cities - Physical Infrastructure, Land Use - Compact/mixed-use development, Transit oriented development (TOD); Smart City Management-Transportation Unified governance structure (UMTA). Smart public transportation, Smart parking, Intelligent traffic management, Detour management; Low emission vehicles, Electric Mobility - Environmental projects etc.

UNIT III **SUSTAINABILITY AND SMART PLANNING** **10**

Relationship Between Sustainability and Smart planning - Place making project guidelines- Surveillance, Smart Street Lighting, Intelligent Emergency Services, Intelligent Disaster Forecasting and Management, GIS-based Spatial Decision Support Systems, Smart Communication Service.

UNIT IV **APPLICATION OF TECHNOLOGIES IN SMART CITIES** **8**

Role of Technologies in Smart Cities - Integrated Command and Control Center (ICCC), Data Analytics, Data driven strategies implementation in smart cities.

UNIT V **SMART CITIES PROJECT MANAGEMENT** **9**

Need for project management, Philosophy and concepts; Project phasing and stages; Project organizational structuring: Planning and Scheduling: Project cost analysis; Procurement and Contracting: PPP: Project Monitoring and Evaluation: Risk Management; Case studies.

TOTAL : 45 PERIODS

**OUTCOMES:**

1. Understand the basics of Urbanisation and the role of smart cities.
2. Gain knowledge on implementation of smart physical infrastructure.
3. Understand the role of smart planning for sustainable development.
   Comprehend the knowledge of Technologies in Smart City planning.
4. Reviewing the case studies of smart city projects.

**REFERENCE BOOKS:**


1. P Sharma , “Sustainable Smart cities in India, Challenges and Future Perspectives”, SpringerLink, 2017.
2. Sameer Sharma,“Smart Cities Unbounded- Ideas and Practice of Smart Cities in India”,Bloomsbury India, 2018.
3. Binti Singh, ManojParmar, “Smart City in India Urban Laboratory, Paradigm or Trajectory? Routledge India,2019.
4. https://smartcities.gov.in/guidelines#block-habikon-content
5. https://smartnet.niua.org/learn/library.

| 21CE1932 | INTELLIGENT TRANSPORTATION SYSTEMS | L | T | P | C |
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OBJECTIVES:

- To learn the fundamentals of ITS and study the ITS functional areas.
- To have an overview of ITS implementation in developing countries.

UNIT I **INTRODUCTION TO ITS** **7**

Fundamentals of ITS: Definition of ITS, Challenges in ITS Development-Purpose of ITS Deployment-Benefits of ITS- Overview of application of ITS inTransportation Planning.

UNIT II **DATA COLLECTION THROUGH ITS** **9**

Sensors & its application in traffic data collection - Elements of Vehicle Location and Route Navigation and Guidance concepts; ITS Data collection techniques – vehicle Detectors, Automatic Vehicle Location (AVL), Automatic Vehicle Identification (AVI), GIS, RFID, video data collection, Internet of Things (IOT).

UNIT III **ITS IN-TRAFFIC MANAGEMENT** **10**

ITS User Needs and Services and Functional areas –Introduction, Advanced Traffic Management systems (ATMS), Advanced Traveller Information systems (ATIS), Advanced Vehicle Control systems (AVCS), Advanced Public Transportation systems (APTS), Advanced Rural Transportation systems (ARTS)- Autonomous Vehicles- Autonomous Intersections.

UNIT IV **ITS IN TRANSPORTATION PLANNING** **10**

ITS and safety, ITS and security- Traffic and incident management systems; ITS and sustainable mobility, travel demand management, electronic toll collection, ITS and road-pricing.; Transportation network operations – public transportation applications- Weight –in Motion.

UNIT V **ITS APPLICATION IN LOGISTICS** **9**

Commercial vehicle operations and intermodal freight-Fleet Management- IT application in freight logistics- E commerce.

TOTAL : 45 PERIODS

**OUTCOMES:**

1. Understand the fundamentals of ITS and its benefits.
2. Gain knowledge on data collection using sensors and its applications.
3. Acquainted with the knowledge of ITS in Traffic Management
4. Application of ITS in Transportation Planning
5. Able to gain knowledge on application of ITS in Logistics

| 21CE1933 | PAVEMENT ENGINEERING | L | T | P | C |
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OBJECTIVES:

- Student gains knowledge on various IRC guidelines for designing rigid and flexible pavements. Further, the student will be in a position to assess quality and serviceability conditions of roads.

UNIT I **PAVEMENT MATERIALS AND SUBGRADE ANALYSIS** **8**

Introduction – Pavement as layered structure – Pavement types -rigid and flexible-Sub-grade analysis- Stress and deflections in pavements- Pavement Materials and Testing- Modified Binders.

UNIT II **DESIGN OF FLEXIBLE PAVEMENTS** **10**

Flexible pavement design – Advantages and disadvantages -Factors influencing design of flexible pavement, Empirical – Mechanistic empirical and theoretical methods – Design procedure as per IRC guidelines – Design and specification of rural roads.

UNIT III **DESIGN OF RIGID PAVEMENTS** **9**

Cement concrete pavements Factors influencing CC pavements – Modified Westergaard approach

– Design procedure as per IRC guidelines – Concrete roads and their scope in India.

UNIT IV **PAVEMENT CONSTRUCTION, EVALUATION AND MAINTENANCE** **10**

Construction Techniques practice of flexible and concrete pavement Pavement Evaluation - Causes of distress in rigid and flexible pavements – Evaluation based on Surface Appearance, Cracks, Patches and Pot Holes, Undulations, Ravelling, Roughness, Skid Resistance. Structural Evaluation by Deflection Measurements - Pavement Serviceability index, - Pavement maintenance (IRC Recommendations only).

UNIT V **STABILIZATION OF PAVEMENTS** **8**

Stabilization with special reference to highway pavements – Choice of stabilizers – Testing and field control - Stabilization for rural roads in India – Use of Geosynthetics in roads.

TOTAL : 45 PERIODS

**OUTCOMES:**

Students will be able to

1. Get knowledge about types of rigid and flexible pavements.
2. Able to design of rigid pavements.
3. Able to design of flexible pavements.
4. Determine the causes of distress in rigid and flexible pavements.
5. Understand stabilization of pavements, testing and field control.

**Text Books:**


1. Khanna, S.K. and Justo C.E.G.and Veeraragavan, A, “Highway Engineering”, New Chand and Brothers, Revised 10th Edition,2014.
2. Kadiyali, L.R., “Principles and Practice of Highway Engineering”, Khannatech. Publications, New Delhi,2015.


**REFERENCES:**


1. Yoder, R.J. and Witchak M.W. “Principles of Pavement Design”, John Wiley2000.
2. Guidelines for the Design of Flexible Pavements, IRC-37–2012, The Indian roads Congress, NewDelhi.
3. Guideline for the Design of Rigid Pavements for Highways, IRC 58-2018, The Indian Road Congress, New Delhi.

| 21CE1934 | TRANSPORTATION PLANNING PROCESS | L | T | P | C |
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OBJECTIVES:

- To impart knowledge in the rudiments and stages in Transportation Planning Process.

UNIT I **TRANSPORTATION PLANNING PROCESS** **8**

Importance of transportation planning, Integration of Land Use and Transport; Systems Approach to Transport Planning; Four Steps in the Transport Planning Process; Travel Demand Modelling Approach; Traffic Analyses Zones – internal and external; Various Transportation Surveys for the collection of data – methodology, analyses of data and presentation of results.

UNIT II **TRIP GENERATION STAGE** **9**

Definition and importance; Trip Production and Attraction, Types of trips; Factors governing trip generation: population related data, land and building use, socio-economic, Trip generation models: Types, Assumptions made, Multiple Linear Regression, category analysis- merits and de-merits of the model, verification, calibration and validation of the model.

UNIT III **TRIP DISTRIBUTION STAGE** **10**

Definition and objective; Data collection, analyses and presentation of trip matrix table, Desire Line Diagram, Development of Gravity, growth factor methods for Trip Distribution, Calibration of gravity model and its validation.

UNIT IV **MODAL SPLIT STAGE** **9**

Factors influencing mode choice - Household characteristics; Zonal Characteristics; Network characteristics - Modal split: pre distribution or post.

UNIT V **TRAFFIC ASSIGNMENT STAGE** **9**

Meaning and objective; General principles; Assignment Techniques- all-or-nothing assignments, multiple route assignment, capacity restraint, diversion curves, Trip assignment route selection; Mode-wise trip matrices; element of transportation network, nodes and links, speed flow curves, minimum path trees.

TOTAL : 45 PERIODS

**OUTCOMES:**

Students will be able to

1. Understand the principles of the transportation planning process and methods of data collection.
2. Acquainted with the trip production, trip attraction models and calibration.
3. Acquainted with the trip production, trip attraction models and calibration.
4. Able to understand trip distribution models and its application.
5. Gain knowledge on the mode choice behaviour and mode split models.

**Text Books:**


1. 1.Kadiyali. L.R., Traffic Engineering and Transport Planning, Khanna Publishers, Delhi, 2019.
2. C.S. Papacostas and P.D. Prevedouros, Transportation Engineering and Planning, PrenticeHall of India Pvt. Ltd., 2009.
3. 3. Michael J.Bruton, Introduction to Transportation Planning, Hutchinson, London, 1995.


**REFERENCES**


1. J D Ortuzar and L G Willumnsen. Modeling Transport. John Wiley and Sons, New York, 2011.

2. John W. Dickey, Metropolitan Transportation Planning, Tata McGraw Hill Publishing Company Ltd., New Delhi, 1990.
3. C. Jotin Khisty, Kent Lall, Transportation Engineering: An Introduction, Prentice Hall, 1998
4. De Dios Ort zar and Luis G. Willumsen, Modelling Transport, John Wiley & Sons 2001
5. Chennai Comprehensive Traffic Study, Chennai Metropolitan Development Authority, 2007.
6. James H.Banks, Introduction to Transportation Engineering, Tata McGraw Hill Education Pvt Ltd, 2010.

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| **21CE1935** | **AIRPORTS AND HARBOURS** | **3** | **0** | **0** | **3** |

OBJECTIVES:

- To introduce the students about airport planning, design, construction and planning design principles of seaport.

UNIT I **AIRPORT PLANNING** **7**

Air transport characteristics - airport classification – ICAO - airport planning: Site selection typical Airport Layouts, Case Studies, parking and Circulation Area.

UNIT II **AIRPORT COMPONENTS** **9**

Airport Classification, Planning of Airfield Components – Runway, Taxiway, Apron, Hangar- Passenger Terminals- Geometric design of runway and taxiways-Runway pavement Design- Difference between Highway and airport pavements- Introduction to various design methods- Airport drainage.

UNIT III **AIRPORT DESIGN** **10**

Runway Design: Orientation, Wind Rose Diagram, Problems on basic and Actual Length, Geometric Design – Elements of Runway Design – Airport Zones – Passenger Facilities and Services – Runway and Taxiway Markings- Air Traffic Control Tower- Instrumental Landing.

UNIT IV **SEAPORTS COMPONENTS AND CONSTRUCTION** **10**

Definition of Basic Terms: Harbor, Port, Satellite Port, Docks- Dry and Floating Dock, Waves and Tides – Planning and Design of Harbors: Harbour Layout and Terminal Facilities – Coastal Structures: Piers, Break waters, Wharves, Jetties, Quays, Spring Fenders, Dolphins Floating Landing Stage – Navigational Aids-Inland Water Transport.

UNIT V **SEAPORT REGULATIONS AND EIA** **9**

Wave action on Coastal Structures and Shore Protection and Reclamation – Coastal Regulation Zone, 2011-EIA – methods of impact analysis and its process.

TOTAL : 45 PERIODS

**OUTCOMES:**

The students completing the course will have

1. Gain an insight on the planning and site selection of Airport Planning and design.
2. Knowledge on Design of various Airport components
3. Analyze and design the elements for orientation of runways and passenger facility systems.
4. Understand the various features in Harbours and Ports, their construction, coastal protection works
5. Knowledge on various Environmental Regulations and Acts.

**Text Books:**


1. Khanna.S.K. Arora.M.G and Jain.S.S, Airport Planning and Design, Nemachand and Bros, Roorkee,1994 .
2. Robert Honjeff and Francis X.Mckelvey, "Planning and Design of Airports", McGraw Hill, New York,1996 2. Richard De Neufille and Amedeo Odoni, "Airport Systems Planning and Design", McGraw Hill, New York,2003
3. Subramanian K.P., Highways, Railways, Airport and Harbour Engineering,Scitech Publications (India), Chennai, 2010


**REFERENCES:**


1. Venkatramaiah. C., Transportation Engineering-Vol.2 Railways, Airports, Docks and Harbours, Bridges and Tunnels.,Universities Press (India) Private Limited, Hyderabad, 2015.
2. Mundrey J S, Railway Track Engineering, McGraw Hill Education ( India) Private Ltd, New Delhi, 2013.

## VERTICAL –VI ENVIRONMENT

| 21CE1936 | AIR AND NOISE POLLUTION CONTROL ENGINEERING | L | T | P | C |
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OBJECTIVES:

- To impart knowledge on the sources, affects and control techniques of air pollutants and noise pollution.

**UNIT I GENERAL 9**

Atmosphere as a place of disposal of pollutants– Air Pollution – Definition-Air Pollution and Global Climate - Units of measurements of pollutants - Air quality criteria - emission standards National ambient air quality standards – Air pollution indices-Air quality management in India.

**UNIT II SOURCES, CLASSIFICATION AND EFFECTS 9**

Sources and classification of air pollutants-Manmade-Natural Sources-Type of air pollutants - Pollution due to automobiles - Analysis of air pollutants - Chemical, Instrumental and biological methods. Air pollution and its effects on human beings, plants and animals - Economic effects of air pollution - Effect of air pollution on meteorological conditions-Changes on the Mesoscale, Microscale and Macroscale

**UNIT III SAMPLING, METEOROLOGY AND AIR QUALITY MODELLING 9**

Sampling and measurement of particulate and gaseous pollutants – Ambient air sampling – Stack sampling. Environmental factors - Meteorology - temperature lapse rate and stability – Adiabatic lapse rate – Wind Rose - Inversion – Wind velocity and turbulence -Plume behavior – Dispersion of air pollutants- Air Quality Modeling.

**UNIT IV AIR POLLUTION CONTROL MEASURES 9**

Control-Sourcecorrectionmethods-Controlequipment-Particulatecontrolmethods–Bag house filter- Settling chamber-cyclone separators-inertial devices-Electrostatic precipitator-scrubbers - Control of gaseous emissions - Absorption - Absorption equipment's - adsorption and combustion devices (Theory and working of equipment's only).

UNIT V **NOISE POLLUTION AND ITS CONTROL 9**

Sources of noise– Units and Measurements of Noise-Characterization of Noise from Construction, Mining, Transportation and Industrial Activities, Airport Noise–General Control Measures–Effects of noise pollution–auditory effects ,non-auditoryeffects.NoiseMenace–PreventionandControlofNoisePollution Control of noise at source, control of transmission, protection of exposed person- Control of other types of Noise Sound Absorbent.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

At the End of the Course, Learners will be able to:

1. Understand various types and sources of air pollution and its effects
2. Know the dispersion of air pollutants and their modeling
3. Know about the principles and design of control of particulate pollutants
4. Understand the principles and design of control of gaseous pollutant
5. Know the sources, effects and control of vehicular, indoor air and noise pollution

**TEXT BOOKS:**


6. C.S.Rao, "Environmental Pollution Control Engineering", Wiley Eastern Limited, 2006.
7. M.N.Rao,H.V.N.Rao,Airpollution,TataMcGrawHillPvtLtd,NewDelhi,2017
8. Dr.Y.Anjaneyulu,"AirPollutionandControlTechnologies",AlliedpublishersPvt.Ltd.,2019


**Reference Books:**

1. NoelDeNevers, "Air pollution control Engineering", McGraw Hill International Edition, McGraw Hill Inc, NewDelhi, 2000.
2. AirPollutionact,India,1987
3. PetersonandE.GrossJr.,“HandBookofNoiseMeasurement”,7thEdition,1974
4. Mukherjee,"EnvironmentalPollutionandHealthHazards",causesandeffects,1986
5. Antony Milne, “Noise Pollution: Impact and Counter Measures”, David &CharlesPLC,1979.
6. Kenneth wark, Cecil F.Warner, “Air Pollution its Origin and Control”, Harper and Row Publishers, NewYork, 1998

| 21CE1937 | ENVIRONMENTAL IMPACT ASSESSMENT | L | T | P | C |
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OBJECTIVES:

- To expose the students to the need, methodology, documentation and usefulness of environmental impact assessment and to develop the skill to prepare environmental management plan. To provide knowledge related to the broad field of environmental risk assessment, important processes that control contaminant transport and tools that can be used in predicting and managing human health risks

**UNIT I INTRODUCTION 9**

Historical development of Environmental Impact Assessment (EIA). Environmental Clearance- EIA in project cycle .legal and regulatory aspects in India–types and limitations of EIA–EIA process screening – scoping - terms of reference in EIA- setting – analysis – mitigation. Cross sectoral issues–public hearing in EIA- EIA consultant accreditation

**UNIT II IMPACT INDENTIFICATION AND PREDICTION 9**

Matrices–networks–checklists–cost benefit analysis–analysis of alternatives–expert systems in EIA. Prediction tools for EIA – mathematical modeling for impact prediction – assessment of impacts–air–water–soil–noise–biological—cumulative impact assessment

**UNIT III SOCIO-ECONOMIC IMPACT ASSESSMENT 9**

Socio-economic impact assessment-relationship between social impacts and change in community and institutional arrangements. Factors and methodologies- individual and family level impacts. Communities in transition-rehabilitation

**UNIT IV EIA DOCUMENTATION AND ENVIRONMENTAL MANAGEMENT PLAN 9**

Environmental management plan - preparation, implementation and review – mitigation and rehabilitation plans – policy and guidelines for planning and monitoring programmes – post project audit – documentation of EIA findings – ethical and quality aspects of environmental impact assessment

**UNIT V CASESTUDIES 9**

Mining, power plants, cement plants, highways, petroleum refining industry, storage & handling of hazardous chemicals, common hazardous waste facilities, CETPs, CMSWMF ,building and construction projects.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

At the End of the Course, Learners will be able to:

1. Apply the principle of limit state design for concrete pipe design
2. Do structural design of Watertanks
3. Design the water treatment plant Structures.
4. Design the components of wastewater treatment plant structures.
5. Apply the knowledge of structural design to various environmental engineering structures.

**Reference Books:**


1. Canter,L.W.,"EnvironmentalImpactAssessment",McGrawHill,NewYork.1996
2. Lawrence,D.P.,"Environmental Impact Assessment–Practical solutions to recurrent problems",Wiley-Interscience,NewJersey.2003
3. World Bank– Source book on EIA
4. Cutter,S.L.,"Environmental Risk and Hazards",Prentice-HallofIndiaPvt.Ltd.,NewDelhi,1999.
5. KolluruRao, BartellSteven, PitbladoR and Stricoff"Risk Assessment and Management Handbook", McGraw HillInc.,New York,1996.

6. K.V.Raghavanand AA. Khan, "Methodologies in Hazard Identification and Risk Assessment", Manual byCLRI,1990.
7. Sam Mannan, Lees' Los sPrevention in the Process Industries ,Hazard Identification, Assessment and Control,4th Edition, Butterworth Heineman,2012.

| 21CE1938 | INDUSTRIAL WASTE WATER MANAGEMENT | L | T | P | C |
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**OBJECTIVES:**

- To impart knowledge on the concept and application of Industrial pollution prevention, cleaner technologies, industrial waste water treatment and residue management. Understand principles of various processes applicable to industrial wastewater treatment. Identify the best applicable technologies for waste water treatment from the perspective of yield production.

**UNIT I INTRODUCTION 9**

Industrial scenario in India–Industrial activity and Environment-Uses of Water by industry– Sources and types of industrial wastewater – Nature and Origin of Pollutants - Industrial wastewater and environmental impacts – Regulatory requirements for treatment of industrial wastewater – Industrial waste survey – Industrial wastewater monitoring and sampling – generation rates, characterization and variables –Toxicity of industrial effluents and Bioassay tests – Major issues on water quality management.

**UNIT II INDUSTRIAL POLLUTION PREVENTION & WASTE MINIMISATION 9**

Prevention vis a vis Control of Industrial Pollution – Benefits and Barriers – Waste management Hierarchy - Source reduction techniques – Periodic Waste Minimization Assessments– Evaluation of Pollution Prevention Options – Cost benefit analysis – Pay-back period – Implementing &Promoting Pollution Prevention Programs in Industries.

**UNIT III INDUSTRIALWASTE WATER TREATMENT 9**

Flow and Load Equalization–Solids Separation–Removal of Fats, Oil & Grease-Neutralization-Removal of Inorganic Constituents– Precipitation ,Heavy metal removal, Nitrogen & Phosphorous removal, Ion exchange , Adsorption , Membrane Filtration , Electro dialysis & Evaporation – Removal of Organic Constituents – Biological treatment Processes, Chemical Oxidation Processes, Advanced Oxidation processes–Treatability Studies

**UNIT IV WASTE WATER REUSE ANDRESIDUAL MANAGEMENT 9**

Individual and Common Effluent Treatment Plants – Joint treatment of industrial and domestic wastewater-Zero effluent discharge systems-Quality requirements for Wastewater reuse Industrial reuse , Present status and issues - Disposal on water and land – Residuals of industrial wastewater treatment – Quantification and characteristics of Sludge – Thickening, digestion, conditioning, dewatering and disposal of sludge–Management of RO rejects.

**UNIT V CASESTUDIES 9**

Industrial manufacturing process description, wastewater characteristics ,source reduction options and waste treatment flow sheet for Textiles – Tanneries – Pulp and paper – metal finishing – Sugar and Distilleries

**TOTAL : 45 PERIODS**

**OUTCOMES:**

At the End of the Course, Learners will be able to:

1. Explain the source and types of industrial wastewater and their environmental impacts and choose the regulatory laws pertaining to environmental protection

2. Identify industrial wastewater pollution and implement pollution prevention ,waste minimization in industries
3. Apply knowledge and skills to design industrial wastewater treatments
4. Audit and analyze environmental performance of industries to internal, external client, regulatory bodies and design water reuse management techniques
5. Conduct research to develop effective management systems for industrial wastewater that are technically sound, economically feasible and socially acceptable

**Reference Books:**


1. "Industrial wastewater management, Treatment& disposal, Water Environment" FederationAlexandria Virginia, Third Edition,2008.
2. LawrenceKwang, Yung Tse Hung, Howard H.Lo and Constantine Yapijakis"handlook of Industrial and Hazardous waste Treatment",SecondEdition,2004.
3. Metcalf &Eddy,Inc., George Tchobanoglous ,FranklinL. BurtonandH.DavidStensel, Wastewater engineering, treatment and reuse,FourthEdition,McGraw-Hill,2017
4. Nelson Leonard Nemerow,"industrialwasteTreatment",Elsevier,2007.
5. WyEckenfelderW.,"IndustrialWaterPollutionControl",SecondEdition, McGraw-Hill, 2000.
6. Paul Bishop, Pollution Prevention: Fundamentals and Practice", Mc-Graw HillInternational, Boston, 2000.
7. Wastewater Treatment for pollution control and reuse by Soli.J. Arceivala, Shyam.R.Asolekar, TataMcGrawHill, 2000.

| 21CE1939 | SOLIDAND HAZARDOUSWASTE MANAGEMENT | L | T | P | C |
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OBJECTIVES:

To impart knowledge on the concept and application of Industrial pollution prevention, To impart knowledge and skills relevant to minimization, storage, collection, transport, recycling, processing and disposal of solid and hazardous wastes including the related regulations, engineering principles, design criteria, methods and equipment.

**UNIT I** **WASTE CLASSIFICATION AND REGULATORY REQUIREMENTS** **9**

Sources and types of solid and hazardous wastes-need for solid and hazardous waste management – Salient features of latest Indian legislations on management and handling of solid wastes, hazardous wastes, biomedical wastes, electronic wastes, construction and demolition wastes, plastics and discarded lead acid batteries – elements of integrated waste management and roles of stakeholders - seven elements and seven step approach to integrated solid waste management planning

**UNIT II** **WASTE CHARACTERIZATION SOURCE REDUCTION AND RECYCLING** **9**

Waste sampling and characterization plan - waste generation rates and variation – physical composition, chemical and biological properties–hazardous characteristics–ignitability,corrosivity and TCLP tests –source reduction ,segregation and on sites to rage of wastes–wasteexchange-extendedproducerresponsibility-recyclingofplastics, C&D wastes andE wastes.

**UNIT III** **WASTE COLLECTION TRANSPORT AND MATERIAL RECOVERY** **9**

Door to door collection of segregated solid wastes –analysis of hauled container and stationery container collection systems-compatibility, storage, labeling and handling of hazardous wastes– principles and design of transfer and transport facilities - hazardous waste transport and manifests – mechanical processing and material separation technologies–Size reduction–size separation-density separation - magnetic separation – compaction – principles and design of material recovery facilities–physiochemical treatment of hazardous wastes-solidification and stabilization–case studies on waste collection and material recovery

**UNIT IV** **BIOLOGICAL AND THERMAL PROCESSING OF WASTES** **9**

Biological and thermos-chemical conversion technologies – composting – bio methanation – incineration – pyrolysis- plasma arc gasification –principles and design of biological and thermal treatment facilities-MSW processes to energy with high-value products and specialty By- products - operation of facilities and environmental controls - treatment of biomedical wastes – case studies and emerging waste processing technologies..

**UNIT V** **WASTE DISPOSAL** **9**

Sanitary and secure landfills - components and configuration– site selection - liner and cover systems-geo synthetic clay liners and geo membranes-design of sanitary landfills and secure landfills- leachate collection, treatment and landfill gas management – landfill construction and operational controls - landfill closure and environmental monitoring – landfill bioreactors

–rehabilitation of open dumps and bio mining of dumpsites-remediation of contaminated sites- Case studies

**TOTAL : 45 PERIODS**

**OUTCOMES:**

At the End of the Course, Learners will be able to:

1. Explain the various functional elements of solid and hazardous waste management including the associated legal, health, safety, and cultural issues as well as responsibilities of different stakeholders
2. Apply the knowledge of science and engineering fundamentals to characterize different types of solid and hazardous wastes, assess the factors affecting variation and assess performance of waste treatment and disposal systems
3. Design of systems and processes to meet specified needs of waste minimization, storage, collection, transport, recycling, processing and disposal.
4. Select appropriate methods for processing and disposal of solid and hazardous wastes, taking into account the impact of the solutions in a sustainability context
5. Conduct research pertinent to solid and hazardous waste management and communicate effectively to different stakeholders as well as engage in independent lifelong learning

**Reference Books:**


1. GeorgeTchobanoglous, Hilary Theisen and SamuelA, Vigil,"IntegratedSolidWasteManagement,Mc-GrawHillIndia,Firstedition,2015.
2. CPHEEO, "Manual on Municipal Solid waste management, VolI,II and III,Central Public Health and Environmental Engineering Organisation ,GovernmentofIndia,NewDelhi,2016.
3. William A. Worrell, P. AarneVesilind, Christian Ludwig, Solid Waste Engineering – A Globalerspective,3rd Edition, CengageLearning,2017.
4. Michael D. LaGrega, Philip L Buckingham, Jeffrey C. E vans and "Environmental Resources Management, Hazardous waste Management",Mc-GrawHillInternationaledition,NewYork,2010.
5. John Pitchtel, Waste Management Practices, CRC Press, Taylor and Francis Group,2014.
6. GaryC.Young,MunicipalSolidWastetoEnergyConversionProcesses:Economic,Technical,andR enewableComparisons,Wiley,2010
7. CherryPM, Solid and Hazardous Waste Management, CBS publishers and distributors PvtLtd,2018.
8. RaoM.N, Razia Sultana, Sri HarshaKota ,solid and hazardous waste management– ScienceandEngineering,Butterworth-Heinemann,2014.

| 21CE1940 | ENVIRONMENTAL POLICY AND LEGISLATIONS | L | T | P | C |
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**OBJECTIVES:**

The course will analyze the legislative and judicial responses to environmental problems and the administrative system of environment related laws such as air, water, land, and hazardous substances etc. Environment advocacy and approaches for using litigation in environment protection will receive special attention

**UNIT I** **INTRODUCTION TO ENVIRONMENTAL LEGISLATIONS AND INTERNATIONAL SCENARIO** **9**

Significance of Environmental Law -International Environmental Law -Development of International Environmental Law -Source and General principals of International Environmental Law –General rights and obligations of States -General Issues of the international law related to environmental protection-Stockholm Declaration-Rio Declaration on Environment and Development-Base Convention on the Control of Trans boundary Movement of Hazardous Wastes and their disposal-Convention of Biological Diversity -U.N Frame Work Convention on Climate Change-Montreal Protocol on Substances that deplete Ozone Layer-Kyoto Protocol.

**UNIT II** **INDIAN CONSTITUTIONS AND ENVIRONMENTAL PROTECTION** **9**

Indian Constitution and Environmental Protection-Constitutional provisions concerning Environment Articles 14,15,(2) (b) 19 (e),21,31,32,38,39,42,47, 48-A,49,51,51-A: Indian Environmental Policy 2006 Administrative machinery for pollution control Common Law & Criminal Law Nuisance ,Negligence, Strict liability and Absolute liability, Provisions of IPC relating to environmental problems (public nuisance u/s 268 and others (Sections 269,270,277,284,285,286,425 to 440) Section 133 of Cr.P.C.

**UNIT III** **REMEDIES FOR ENVIRONMENTAL POLLUTION** **9**

Common Law Remedies/Remedies under Law of Tort – Penal Remedies – Indian Penal Code and Code of Criminal Procedure–Remedies under Constitutional Law–Writs–Public Interest Litigation -Public Liability Insurance Act, 1991–The National Green Tribunal Act2010

**UNIT IV** **MAJOR INDIAN LEGISLATIONS** **9**

Water Act (1974) Air Act (1981) Environmental Protection Act (1986) Major Notifications, The Municipal solid Wastes (Management and Handling) Rules2000-Bio Medical Wastes (Management and Handling) Rules 1998-Hazardous Wastes (Management and Handling Rules1989-Environment Impact Assessment Notifications-Coastal Regulation Zone Notification-Public Hearing Notifications

**UNIT V** **ENVIRONMENT AND DEVELOPMENTCASE LAWS** **9**

Meaning and concept of development-Its impact on environment; conflict between environment and development, Concept of Sustainable Development., Polluter Pay Principle, Precautionary Principle, Public Trust Doctrine .Landmark Judgments-Olium gas leakage case, RuralL Mitigation and Entitlement Kendra, Dehradun, (1985) Supp SCC 487) Vellore Citizen Welfare Forum v. Union of India, (1996) 5SCC 647) Ganga Pollution case (1988) I SCC) S. Jagannath v. UOI (1997) SCC867)Vellore Citizens welfare forum case M.C.MehtaV.Kamalnath (1997)ISCC388)

**TOTAL : 45 PERIODS**

**OUTCOMES:**

At the End of the Course, Learners will be able to:

1. Understand origins and sources of environmental laws, and understand how and by whom environmental laws are made and interpreted
2. Understand the key principles of, and actors within, environmental laws
3. UnderstandtheNationalEnvironmentalPolicyandVariousLegislationsenactedin

line with Policy

4. Critically analyze environmental laws within various contexts and to evaluate laws against procedure land substantive criteria.
5. Understand and the Legal system operating in India and will be in a position to prepare compliance reports for getting environmental clearance.

**Reference Books:**


1. LeelakrishnanP.,EnvironmentalLawinIndia,Butterworths,1998
2. LeelakrishnanP.,EnvironmentalCaseBook,LexisNexis,2000
3. ShanthakumarS.,EnvironmentalLaw–AnIntroduction,Butterworths,2004
4. Shyam Diwan and Armin Rosencranz, Enviromental Law and Policy in India, Oxford,2001


| 21CE1941 | ENVIRONMENTAL HEALTH AND SAFETY | L | T | P | C |
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**OBJECTIVES:**

• To educate overview of EHS in industries and related Indian regulations, types of Health hazards, effect, assessment and control methods and EHS Management System

**UNIT I INTRODUCTION 9**

Need for developing Environment, Health and Safety systems in workplaces-International initiatives, National Policy and Legislations on EHS in India - Regulations and Codes of Practice – Role of trade union safety representatives-Ergonomics.

**UNIT II OCCUPATIONAL HEALTH AND HYGIENE 9**

Definition of occupational health and hygiene - Categories of health hazards – Exposure pathways and human responses–Exposure Assessment-occupational exposure limits - Hierarchy of control measures –Role of personal protective equipment and the selection criteria

**UNIT III WORK PLACE SAFETYAND SAFETY SYSTEMS 9**

Safety appraisal – Job Safety Analysis-Control techniques – plant safety inspection – Accident investigation-Analysis and Reporting –Hazard and Risk Management Techniques–Onsite and offsite emergency Plans. Employee Participation-Education and Training-Case Studies

**UNIT IV ENVIRONMENTAL HEALTH AND SAFETY MANAGEMENT 9**

Concept of Environmental Health and Safety Management – Elements of Environmental Health and Safety Management Policy and implementation and review–ISO45001-Strucure and Clauses-Case Studies

**UNIT V ENVIRONMENT AND DEVELOPMENT CASE LAWS 9**

Meaning and concept of development-Its impact on environment; conflict between environment and development, Concept of Sustainable Development., Polluter Pay Principle, Precautionary Principle, Public Trust Doctrine .Landmark Judgments-Olium gas leakage case, Rural Mitigation and Entitlement Kendra, Dehradun, (1985) Supp SCC 487) Vellore Citizen Welfare Forum v. Union of India, (1996) 5SCC 647) Ganga Pollution case (1988) I SCC) S. Jagannath v. UOI (1997) SCC867)Vellore Citizens welfare forum case M.C.MehtaV.Kamalnath (1997)ISCC388)

**TOTAL : 45 PERIODS**

**OUTCOMES:**

At the End of the Course, Learners will be able to:

1. Need for EHS in industries and related Indian regulations
2. Various types of Health hazards ,effect, assessment and control methods
3. Various safety systems in working environments
4. The methodologyforpreparationofEmergencyPlansandAccidentinvestigation
5. EHS Management System and its elements

**Reference Books:**


1. Industrial Health and Safety Acts and Amendments, by Ministry of Labor and Employment, Government of India.
2. Fundamental of Industrial Safety and Health by Dr.K.U.Mistry, Siddharth Prakashan, 2012
3. The Facility Manager's Guide to Environmental Health and Safety by Brian Gallant, Government Inst Publ.,2007.

4. Effective Environmental, Health, and Safety Management Using the Team Approach by BillTaylor, Culinary and Hospitality Industry Publications Services,2005.
5. Environmental and Health and Safety Management by Nicholas P.Cheremisin off and MadelynL.Graffia,WilliamAndrewInc.NY,1995

| 21CE1942 | CLIMATE CHANGE ADAPTATION AND MITIGATION | L | T | P | C |
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**OBJECTIVES:**

- To impart knowledge on the global warming, the impact of climate change on society and the adaptation and mitigation measures to the students

**UNIT I INTRODUCTION 9**

Atmosphere – weather and Climate - climate parameters – Temperature, Rainfall, Humidity, Wind – Global ocean circulation – El Nino and its effect - Carbon cycle

**UNIT II ELEMENTS RELATED TO CLIMATE CHANGE 9**

Green house gases - Total carbon dioxide emissions by energy sector – industrial, commercial, transportation, residential – Impacts – air quality, hydrology, green space - Causes of global and regional climate change – Changes in patterns of temperature, precipitation and sea level rise – Greenhouse effect

**UNIT III IMPACTS OF CLIMATE CHANGE 9**

Effects of Climate Changes on living things – health effects, malnutrition, human migration, socioeconomic impacts- tourism, industry and business, vulnerability assessment- infrastructure, population and sector – Agriculture, forestry, human health, coastal areas

**UNIT IV MITIGATING CLIMATE CHANGE 9**

IPCC Technical Guidelines for Assessing Climate Change Impact and Adaptation -Identifying adaption options – designing and implementing adaption measures – surface albedo environment-reflective roofing and reflective paving – enhancement of evapo transpiration - tree planting programme – green roofing strategies – energy conservation in buildings – energy efficiencies – carbon sequestration

**UNIT V ALTERNATE FUELS AND RENEWABLE ENERGY 9**

Energy source – coal, natural gas – wind energy, hydropower, solar energy, nuclear energy, geothermal energy–bio fuels–Energy policies for a cool future-Energy Audit.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

At the End of the Course, Learners will be able to:

1. An insight into carbon cycle, physical basis of the natural greenhouse effect, including the meaning of the term radiative forcing, climate change, global warming and measures to adapt and to mitigate the impacts of climate change
2. understandingonthegrowingscientificconsensusestablishedthroughtheIPCCaswellast hecomplexities and uncertainties
3. Ability to plan climate change mitigation and adaptation projects including the use of alternate fuels and renewable energy
4. Gain in-depth knowledge on climate models
5. Post process the model outputs for climate impact assessment, know about adaptation strategies

**Reference Books:**

1. 1.Ruddiman W.F, freeman W.H. and Company, “Earth‟s Climate Past and Future”, 2001
2. Velma. I. Grover “Global Warming and Climate” Change. Vol I an II. Science Publishers, 2005.
3. 3.Dash Sushil Kumar, “Climate Change – An Indian Perspective”, Cambridge University Press India Pvt. Ltd, 2007

## VERTICAL VII: WATER RESOURCES

| 21CE1943 | PARTICIPATORY WATER RESOURCES MANAGEMENT | L | T | P | C |
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OBJECTIVES:

- To enable the students to understand the regional and global experiences of participatory ideology in irrigation water management
- To help students acquire knowledge on paradigms shifts and reorientations with regard to stakeholder participation in water management in general and in irrigation management in particular.

UNIT I **FUNDAMENTALS OF SOCIOLOGY AND PARTICIPATORY APPROACH** **6**

Basic Sociological concepts and Definitions - Objectives – Perspectives- Social stratification – Sociological understanding - Irrigation as a Socio technical 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 STAKE HOLDERS AND THE UNDERLYING ISSUES** **12**

Multiple use of water–Issues in sectorial 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**

WaterPolicy-IrrigationGovernance-BuildingfromBelow-Non-politicalAssociations-BureaucraticReorientation-PolicyoptionsandAlternativesandSustainability.

TOTAL : 45 PERIODS

**OUTCOMES:**

On completion of the course ,the student is expected to be able to

1. Capture to fundamental concepts and terms which are to be applied and understood all through the study.
2. Acquire a clear insight into the subject matter of participatory ideology with it srudiments under the light of both national and international illustrative cases.
3. Comprehend the roles of different players as stakeholders with the ground reality of the underlying issues in farm community.

4. Articulatea show reform scan help buildup institutional and irrigation agencies with the support obtained from the existing farm network in irrigation Management
5. Gainanoverarchingunderstandingofrecommendationforimprovedirrigationmanagementwithavisiontotransformtheexistinggovernanceandpolicieswiththenovelapproachofsustainability.

**TEXT BOOKS:**


1. DesaiA.R.,Rural sociology in India,Popular Prakashan,Bombay,1969.
2. Michael C.M.,Putting people first, Sociology variables inRuralDevelopment,OxfordUniversitypress,London1985.
3. Up hoff.N.,Improving International Irrigation management with Farmer Participation –Getting the process Right – Studies in water Policy and management, New West - Viewpress,BoulderandLondon,1986.
4. ChambersR.,Managing canal irrigation,Oxford IBM publishing Co.Pvt.Ltd.,NewDelhi,1998.
5. Korten F.Fand Robert Y.Siy,Jr. Transforming a Bureau cracy– The experience of the Philippines National Irrigation Administration,Ateneo De Manila University Press,Manila,1989.


**Reference Books:**


1. SivasubramaniumK.,WaterManagement SIMRESPublication,Chennai2009.
2. http://irapindia.org/IMTInIndia-Pa
3. http://mowr.gov.in/writereaddata/mainlinkFile/File421.pdf

| 21CE1944 | GROUND WATER ENGINEERING | L | T | P | C |
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OBJECTIVES:

- The objective of this course is enable the student to understand the principles of Ground water governing Equations, Characteristics of different aquifers and techniques of ground water model development and management.

UNIT I **HYDRO GEOLOGICAL PARAMETERS** **9**

Introduction–Water bearing Properties of Rock–Type of aquifers-Aquifer properties– permeability, specific yield, transmissivity and storage coefficient–Methods of Estimation–GEC norms Steady state flow-Darcy's Law –Ground water Velocity–-Dupuit For chheimer assumption–Steady Radial Flow into a Well

UNIT II **WELL HYDRAULICS** **9**

Unsteady state flow-The is method-Jacob method–Chow's method–Law of Times–The is Recovery – Bailer method – Slug method - tests - Image well theory – Partial penetrations of wells –Well losses–Specific Capacity and Safe yield-Collector well and Infiltration gallery

UNIT III **GROUND WATER MANAGEMENT** **9**

Need for Management Model – Database for Ground water Management – Ground water balance study –Introduction to Mathematical model – Model Conceptualization – Initial and Boundary Condition –Calibration– Validation – Future Prediction – Sensitivity Analysis – Uncertainty –Development of a model

UNIT IV **GROUND WATER QUALITY** **9**

Ground water chemistry-Origin, movement and quality-Water quality standards–Drinking water Industrial water– Irrigation water- Ground water Pollution and legislation - Environmental Regulatory requirements

UNIT V **GROUND WATER CONSERVATION** **9**

Artificial recharge techniques–Reclaimed waste water recharge–Soil aquifer treatment(SAT)– Aquifer Storage and Recovery(ASR) Seawater Intrusion and Remediation–Groundwater Basin management and Conjunctive use–Protection zone delineation, Contamination source inventory and remediation schemes

TOTAL : 45 PERIODS

**OUTCOMES:**

At the End of the Course, Learners will be able to:

1. Define the ground water system basic, types of aquifers, aquifer parameters, movement and its potential for confined and unconfined aquifers
2. Apply the knowledge of ground water flow in steady and unsteady flow characteristics of well hydraulics
3. Explain the concept of ground water model development and data base management for ground water management
4. Describe the importance of artificial recharge and ground water quality concepts
5. Apply the creative and innovative technique on conservation of ground water

**Text Books:**


1. RaghunathH.M.,"GroundWaterHydrology",NewAgeInternational(P)Limited,NewDelhi,2010.
2. ToddD.K.,"GroundWaterHydrology",JohnWileyandSons,NewYork,2000.


**Reference Books:**


1. Fitts R Charles, "Ground water Science". Elsevier, AcademicPress,2002.

2. Rama Krishnan S, Ground Water, K.J.Grapharts, Chennai,1998.
3. Chahar BR, Ground water hydrology, McGraw Hill Education (India)PvtLtd,NewDelhi,2015.
4. Rastogi A.K. ,NumericalGroundwaterHydrology,2011

| 21CE1945 | WATER RESOURCES SYSTEMS ENGINEERING | L | T | P | C |
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OBJECTIVES:

- 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.

UNIT I **SYSTEM APPROACH** **9**

Definition, classification, and characteristics of systems-Philosophy of modeling –Goals and Objectives–Basics of system analysis concept–steps in systems engineering.

UNIT II **LINEAR PROGRAMMING** **9**

Introduction to Operation research-Linear programming Problem Formulation-graphical solution Simplex method–Sensitivity analysis-application to operation of single purpose reservoir

UNIT III **DYNAMIC PROGRAMMING** **9**

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

UNIT IV **SIMULATION** **9**

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

UNIT V **ADVANCED OPTIMIZATION TECHNIQUES** **9**

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

TOTAL : 45 PERIODS

**OUTCOMES:**

At the End of the Course, Learners will be able to:

1. Define the economic aspects and analysis of water resources systems for comprehensive and integrated planning of a water resources project.
2. Apply the concept of linear programming for optimization of water resources problems.
3. Explain the concept of dynamic programming and apply in water resource system.
4. Developthesimulationmodelbasedondeterministicandstochasticsimulationforreservoirop eratingpolicy
5. Apply advance optimization techniques like goal programming, heuristicalgorithmin the field of water resources planning and management.

Text Books:

1. Vedula,S.,andMajumdar,P.P.WaterResourcesSystems–ModelingTechniquesandAnalysisTataMcGrawHill,NewDelhi,Fifthreprint,2010.
2. BhavePR,WaterResourcesSystems,NarosaPublishers,2011

**Reference Books:**

1. Gupta,P.K.,and ManMohan, "Problems in Operations Research",(MethodsandSolutions),Sultan Chand and Sons,NewDelhi,1995.

2. Chaturvedi,M.C.,"Water Resources Systems Planning and Management" ,Tata McGrawHill,NewDelhi,1997.
3. Taha,H.A.,"OperationsResearch",McMillanPublicationCo.,NewYork,1995.
4. Hiller, F.S., and Liebermann, G.J., "Operations Research", CBS Publications and Distributions, New Delhi,1992.

| 21CE1946 | WATERSHED CONSERVATION AND MANAGEMENT | L | T | P | C |
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OBJECTIVES:

- To provide the technical and sociological understanding of a water shed.
- To provide a comprehensive discourse on the engineering practices of water shed management for realizing the higher benefits.

UNIT I **WATER SHED CONCEPTS** **9**

Water shed–Definition, Need and Elements –Principles- Influencing Factors: Geology– Soil– Morphological Characteristics- Topo sheet- Delineation–Codification – Prioritization – Water shed 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 WATER SHED MANAGEMENT** **9**

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

UNIT V **WATERSHEDMANAGEMENT** **9**

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

TOTAL : 45 PERIODS

**OUTCOMES:**

At the End of the Course, Learners will be able to:

1. Recognize and Interpret the morphological features of a watershed.
2. State, design and sketch the soil conservation structures.
3. Describe the micro catchment and apply the concepts to design the small water harvesting structures.
4. Illustrate the application of modern tools and technology in the management of watershed.
5. Classify the management activities and to develop an integrated watershed development plan.

Text Books:

1. Ghana shyam 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.

**Reference Books:**

1. Glenn O Schwab. etal, Soil and WaterConservationengineering,WileyIndiaPrivateLimited,2009.
2. Heath cote, I. W. Integrated Watershed Management: Principles and Practice. John Wiley andSons,Inc.,NewYork,SecondEdition2009.
3. John G. Lyon, GIS for Water Resources and Watershed Management,CRCPress,2002.
4. VijayP.Singh, Donald K. Frevert,Watershed Models,CRCPress,2005.
5. VirSingh,Raj, Watershed Planning and Management,Bio-GreenPublisher,2016.

| 21CE1947 | INTEGRATED WATER RESOURCES MANAGEMENT | L | T | P | C |
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OBJECTIVES:

- Students will be introduced to the concepts and principles of IWRM, which is inclusive of the economics, public-private partnership, water & health, water & food security and legal & regulatory settings.

UNIT I **CONTEXT FOR IWRM** **9**

Water as a global issue: Key challenges–Definition of IWRM with in 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 ground water management–World Water Forums–Global Water Partnerships

Development of IWR Min line with legal and regulatory frame work: Case Studies.

UNIT IV **WATER AND HEALTH WITH IN 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 : 45 PERIODS**

**OUTCOMES:**

At the End of the Course, Learners will be able to:

1. Describe the context and principles of IWRM; Compare the conventional and integrated ways of water management.
2. Select the best economic option among the alternatives; illustrate the pros and cons of PPP through case studies.
3. Apply law and governance in the context of IWRM.
4. Discuss the linkages between water-health; develop a HIA framework.
5. Analyze how the virtual water concept paves way to alternate policy options.

Text Books:


1. Cech Thomas V., Principles of water resources: history, development, management and policy. JohnWileyandSonsInc.,NewYork.FourthEdition2018.
2. Mollinga.P. etal "Integrated Water Resources Management", Water in South Asia Volume I, SagePublications,2006.


**Reference Books:**


1. Technical Advisory Committee, Dublin principles for water as reflected in comparative assessment of institutional and legal arrangements for Integrated Water Resources Management, Technical Advisory Committee Background PaperNo:3.Global water partnership,Stockholm,Sweden.1999.
2. Technical Advisory Committee, Integrated Water Resources management, Technical Advisory Committee Background PaperNo:4.Globalwater partnership,Stockholm,Sweden.2002.
3. Technical Advisory Committee, Effective Water Governance".Technical Advisory Committee Background PaperNo:7.Global water partnership,Stockholm,Sweden,2003.
4. Tony Allan, Virtual Water: Tackling the Threat to Our Planet's Most Precious Resource, I. B. Taurus,2011.
5. Convention on the Law of the Non-navigational Uses of International Watercourses.https://legal.un.org/ilc/texts/instruments/english/conventions/8_3_1997.pdf

| 21CE1948 | WATER QUALITY AND MANAGEMENT | L | T | P | C |
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OBJECTIVES:

- To understand the fundamentals of mathematical models and their importance in water quality modelling, and to impart the skills to use water quality modelling software for surface and ground water quality modelling

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' sequations

UNIT IV **GROUND WATER QUALITY MODELLING** **9**

Ground water flow and mass transport of solutes–ground water quality modeling using numerical methods – Parameters, Input-output stresses, Initial and Boundary conditions-degradation of organic compounds in sub surface–Model calibration: steady state and unsteady state–sensitivity analysis–Model validation –sea water intrusion–basic concepts and modelling

UNIT V **WATER QUALITY MANAGEMENT MODELS** **9**

Exposure to surface water and ground water quality modeling software's– MIKE21, WASP, QUAL2E and MODFLOW– demonstration– case studies– Modeling multi layer ground water flow system Artificial recharge feasibility through modeling– Ground water contamination, restoration and management.

**TOTAL : 45 PERIODS**

**OUTCOMES:**

At the End of the Course, Learners will be able to:

1. Know about the principles of water quality modeling.
2. Understand the pollutant transport phenomena in surface and ground water.
3. Apply the knowledge of surface water quality modeling to predict the water quality of rivers, lakes and estuary.
4. Predict the ground water contamination transport.

Predict water quality of surface and subsurface water using numerical solution.

Text Books:


1. Paul.RWolf.,BonA.DeWitt, Elements of Photogrammetry with Application in GIS McGraw Hill International Book Co.,4$^{th}$Edition,2014.
2. E.M.Mikhail,J.S.Bethel,J.C.McGlone,Introduction to Modern Photogrammetry, WileyPublisher, 2001.


**Reference Books:**

1. Steven C. Chapra, "Surface Water Quality Modelling", Tata McGraw-Hill Companies, Inc., NewDelhi2018.
2. "WaterQualityModellingforRiversandStreams"Authors:Benedini,Marcello,Tsakiris,George,SpringerNetherlands2017.
3. **"**Hydrodynamics and WaterQuality**:** Modelling Rivers, Lakes,and Estuaries", Zhen-GangJi,JohnWiley&Sons,2018.
4. "Modelling Ground water Flow and Contaminant Transport By Jacob Bear,A.H.-D.Cheng,SpringerScience&BusinessMedia,2010.
5. "MathematicalModellingofGroundwaterPollution"Ne-ZhengSun,AlexanderSun,SpringerNewYork,2012

| 21CE1949 | URBAN WATER INFRASTRUCTURE | L | T | P | C |
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OBJECTIVES:

- To impart knowledge and skills relevant to water management in the context of urbanization and relate engineering principles to water supply, storm water and waste water management, along with related regulation sand best management practices from around the world.

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 –Rain water harvesting–public education.

UNIT V **WATER GOVERNANCE** **9**

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

TOTAL : 45 PERIODS

**OUTCOMES:**

At the End of the Course, Learners will be able to:

1. Explain various functional elements of urban ecosystem.
2. Calculate urban runoff, compute supply and demand of water, draw hydrograph
3. Compare advantages of Newer techniques of green infrastructure and illustrate benefits
4. Assess the Operation and Maintenance needs of urban water systems
5. Propose best management practices for Indian context

Text Books:


1. Anand Chiplunkar,K Seetharam and Cheon Kheong(ed)(2012), "Good Practices in urban water management"ADB,National University Singapore.
2. Marina Alberti (2008),"Advances in Urban Ecology", SpringeR
3. Mohammad Karamouz ,AliMoridi, SaraNazif(2010),Urban Water Engineering and Management,1stEdition,CRCPress
4. MonzurA.Imteaz, (2019),Urban Water Resources, CRC Press


**Reference Books:**


1. HormozPazwash(2016), "Urbanstormwater management", CRCPress
2. LarryW. Mays,(2004), Urban StormwaterManagementTools, McGraw-Hill Companies
3. JParkinson,OMark(2005)UrbanStormwaterManagementinDevelopingCountries,I WAPublishing

## VERTICAL VIII : OCEAN ENGINEERING

| 21CE1950 | MARINE GEOTECHNICAL ENGINEERING | L | T | P | C |
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OBJECTIVES:

- Students mainly focused in understanding the physical and engineering properties of marine soil deposits and select suitable marine foundation as per project requirements.

UNIT I **MARINE SOIL DEPOSITS** **9**

Marine environment, Physical and engineering properties of marine soils - Specific problems related to marine soil deposits.

UNIT II **SITE INVESTIGATION IN THE CASE OF MARINE SOIL DEPOSITS** **9**

Challenges of site investigation in marine environment, Different site investigation techniques,sampling techniques, Geophysical methods, Recent advancements in site investigationand sampling used fo rmarine soil deposits

UNIT III **BEHAVIOR OF SOILS SUBJECTED TO REPEATED LOADING** **9**

Effect of wave loading on foundations of marine structures, Behavior of marine deposits under cyclic loading, Cyclic behavior of soils based on fundamental theory ofmechanics, Approximate engineering methods.

UNIT IV **FOUNDATIONS IN MARINE SOIL DEPOSITS** **9**

Different offshore and near shore foundations, Gravity platforms, Jack-up rigs, pile foundations. cassions,spudcans

UNIT V **MARINE FOUNDATIONS SUBJECTED TO WAVE LOADING** **9**

Cyclic behavior of soils, empirical models, elastic-plasticmodels, FEM analysis of marine foundations subjected to wave loading.

TOTAL : 45 PERIODS

**OUTCOMES:**

On completion of the course, the student is expected to be able to

1. Understand the physical and engineering properties of marine soil deposits
2. explain the effect of wave loading on physical and engineering properties of marine soil deposits
3. execute investigation program for marine soil deposits
4. design suitable marine foundation as per project requirement
5. develop numerical model and design marine foundation subjected to wave loading

**TEXT BOOKS:**


1. H.G.Poulos.“MarineGeotechnics”,UnwinHymanLtd, London, UK,1988
2. D.V.ReddyandM.Arockiasamy,“OffshoreStructures”,Volume:1,R.E.KreigerPub andCo.,1991
3. D. Thomson and D.J. Beasley,“Handbook of Marine Geotechnical Engineering”,USNavy,2012

| 21CE1951 | COASTALENGINEERING | L | T | P | C |
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OBJECTIVES:

- To provide the students the knowledge of coastal environment and to determine the characteristics of waves.
- To provide the students the knowledge of wave transformation, sediment transport, coastal protection measures and coastal structure design

UNIT I **COASTAL ENVIRONMENT** **9**

Beaches-Coastal features-Coastal Zonation- EEZ -Inshore and Offshore Areas -Mean Sea level-Basics of Tides and Waves-Coastal Morphology.

UNIT II **WAVES DYNAMICS** **9**

Basics of waves- Classification- Wave Theory - Physical Characteristics of different types of waves- Linear Wave Theory - Wave celerity- Velocities-Accelerations- Displacements- Wave dynamics in shallow and deep water conditions

UNIT III **NEAR SHORE WAVE TRANSFORMATION** **9**

Shoaling, refraction, diffraction and breaking–Interaction currents and waves-near shore currents-wave run-up and over topping

UNIT IV **SEDIMENT DYNAMICSAND TRANSPORT** **9**

Introduction to sediments, Sediment Analysis, types and sizes of sediments, sedimentation processes, sediment Supply &movement -Cross-shore sediment transport –Long shore sediment transport- Shoreline Changes- Shore line Evolution- Erosion &Accretion.

UNIT V **SHORE PROTECTION** **9**

Design of shore defense structures; Hard Engineering measures -Seawalls ,Revetments, Bulkheads, Dikes, Groynes, Breakwaters; Soft Engineering measures–Artificial Reefs, Beach nourishment, Dune regeneration, Salt marsh Creation, Bio shields- Case studies

TOTAL : 45 PERIODS

**OUTCOMES:**

On successfully completing this course unit, students will be able to:

1. Understand the basic concepts of coastal environment.
2. Calculate sea state parameters (wave height, wave period, water levels) in shallow and deep water conditions.
3. Understand the principles of near-shore wave transformation.
4. Analysis the sediment and its transport processes.
5. Evaluate measures to protect beaches from erosion due to waves and currents.

**Text Books:**


1. Kamphuis,J.W.,Introductiontocoastalengineeringandmanagement,2000
2. Dean,R.G.andDalrymple,R.A.,WaterwavemechanicsforEngineersandScientists,Prentice-Hall,Inc.,EnglewoodCliffs,NewJersey,1994
3. ManiJ.S,"CoastalEngineeringbook",PHIPublishingCompany,2ndEdition,2021.

| 21CE1952 | OFFSHORE STRUCTURES | L | T | P | C |
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**OBJECTIVES:**

Students mainly focused in understanding the offshore environment, types, suitability, and design concepts of offshore structures as per the appropriate requirements

UNIT I **INTRODUCTION TO OFFSHORE ENVIRONMENT** **9**

Ocean winds- characterization of wind regime-wind velocity profile,Ocean waves-wave parameters-Introduction to Airy's wave theory and its applications-brief about time and frequency domain analysis, brief introduction about ocean currents-tides,seaquakes,Ice environment,Ice-sea interactions.

UNIT II **TYPES OF OFFSHORE STRUCTURES** **9**

Offshore Structures-need for off shore structures. Types of Offshore Structures-components -materials used-design parameters-suitable environment conditions–construction practices –drawbacks-EIA for Offshore structures

UNIT III **FORCES ON OFFSHORE STRUCTURES** **9**

Introduction-Permanent loads-operating loads. Environmental forces-wind force-wave force-current force-seaquake force-Ice force. Force due to tides – Marine growth – Use of API RP 2Aguidelines.

UNIT IV **SUBMARINE PIPELINES AND RISERS** **9**

Pipeline elements-types of pipelines-laying method-materials. Pipe wall thickness verification. Pipeline stability. Design usingDNV81code.

UNIT V **ACCIDENTAL LOADS AND CORROSION** **9**

Fire, Blast and Collision-Behaviour of steel at elevated temperature Fire rating for Hydro carbon fire, Blast Mitigation-Blast walls Collision of boats and energy absorption-Corrosion-Corrosion Mechanism-Types of corrosion-Offshorestructurecorrosionzones Biological Corrosion-Preventive measures of corrosion-Online corrosion monitoring-Corrosion fatigue

**TOTAL : 45 PERIODS**

**OUTCOMES:**

On completion of the course, the student is expected to be able to

1. Understand the offshore environment and technical terms associated with it.
2. Explainthetypesandchoosesuitableoffshorestructuresaccordingtoenvironmentalconditions
3. Investigate various types of forces acting on the offshore structures
4. Adapt appropriate codes to design the submarine pipelines
5. Discuss about the accidental loads and corrosion on offshore structures

**Reference Books:**


1. B.Cgerwick, Jr.Construction of Marine and Offshore Structures, CRC Press, Florida, 2000.
2. Clauss,G,Lehmann,E&Ostergaard,C,OffshoreStructures,Vol.1&2,Springer-Verlag,1992.
3. Reddy, D.VandArockiasamy,M.,OffshoreStructuresVol.1&2,KreigerPubl.Co.1991.
4. Morgan, N., Marine Technology Reference Book, Butter worths, 1990.
5. McClelland, Band Reifel, M. D., Planning and Design of fixed Offshore Platforms, Van Nostrand, 1986.
6. DNV-RP-B101-CorrosionProtectionofFloatingProtectionandStorageUnits, 2007.
7. APIRP2A.Planning,DesigningandConstructingFixedOffshorePlatforms,API.2000

| 21CE1953 | PORT AND HARBOUR ENGINEERING | L | T | P | C |
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**OBJECTIVES:**

- The purpose of this course is to impart the concepts of port and harbor planning, design, implementation and maintenance

UNIT I **INTRODUCTION** **9**

Ports and harbors: Classification of ports & harbours – Port and harbor planning and layout– Meteorological, hydrographic and oceanographic data requirements and measurements for port and harbor design.

UNIT II **PORT AND HARBOUR LAYOUT OPERATIONS** **9**

Port and harbour layout for vessels navigation and cargo handling-port buildings, navigation channels– shore infrastructure and utilities, land reclamation–Dredging-equipment, navigationimprovement, pipelines and cables.

UNIT III **DESIGN OF PORT** **9**

Types and classification of ports and harbours in India, Natural ports and manmade ports, major ports, minor ports; Design of port infrastructures with regards to cargo handling ,cargo storage and integrated transport of goods.

UNIT IV **DESIGN OF HARBOUR** **9**

DesignharbourInfrastructures-designofbreakwater-shoreattachedandoffshorebreakwaters design -harbour basin design, approach channel design, turning basin design, with regards to cargo and passenger terminals

UNIT V **CONSTRUCTION ASPECTS AND SMART PORT** **9**

Planning and construction, expansion of existing jetties and renovation of port –Inland Port Infrastructure – Smart Port : Levels of transformation into a smart port, Artificial Intelligence and Machine Learning, Smart application for ports.

TOTAL : 45 PERIODS

**OUTCOMES:**

On the successful completion of the course, students will be able to

1. Understandtheclassificationofportandharborandstudyaboutthedatarequirementand
2. Measurements for port and harbour structures.
3. Discuss the layout operations for vessel navigation and cargo handling.
4. Explain the design guide lines for port structure.
5. Explain the design guidelines for harbour structure.
6. Describe the construction, maintenance and renovation aspects of ports and understand the concept of Smart Port and Smart application for ports

Text Books:


1. Bruun, Per.Port engineering:vol. Harbor planning, breakwaters, and marine terminals.1989.
2. A.D.Quinn,“DesignandConstructionofPortandMarineStructures”,McGraw-HillBookCompany,2ndEdition,1972.
3. J.W.Gaythwaite,VanNostrand,“DesignofMarineFacilitiesfortheBerthing,MooringandRepairofVessels”1990

4. Muir Wood,A.M.,and Fleming.C.A.,"Coastal Hydraulics Sea and Inland PortStructures",1stEdition,HallsteadPress,2002.

| 21CE1954 | COASTAL HAZARDS AND MITIGATION | L | T | P | C |
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OBJECTIVES:

- To provide students understanding of the materials and processes associated with the major natural hazards: floods, earthquakes, tsunamis ,landslides and other coastal hazards
- To be able to mitigate these hazards based on case studies and respond in the event of a disaster by appropriate strategies.

UNIT I **INTRODUCTION** **8**

Introduction to Environmental and Human induced hazards - Natural vs. Man-made hazard – Hazard and disaster, vulnerability, resilience –coping mechanisms

UNIT II **COASTAL HAZARDS** **9**

Coastal hazards- Tsunami, Cyclones, Earthquakes, Storm surges, Coastal erosion, Floods, Sea Level Rise–Technological Hazards – causes – impacts – responses – mitigation strategies –early warning systems.

UNIT III **LAW AND POLICY** **9**

Disaster management law and policy in India – changing pattern of disaster management inIndia– responseandrecoveryframework-enablinginstitutions–institutionalcoordination

UNIT IV **ADAPTATION AND MITIGATION** **10**

CoastalHazardsAdaptationStrategy-Adaptationindigenousknowledge-Sectoraladaptations - Disaster risk response frameworks - Mapping and planning for disaster -Community based disaster MitigationMeasures–IndigenousknowledgefordisasterMitigation-NDMAguidelines

UNIT V **CASESTUDIES** **9**

Case studies of tsunami (2004 Indian Ocean tsunami), Earthquake (Latur), cyclones (Gaja, 2018Tamlnadu), other cyclones, coastal erosion, oil spills, chemical disasters, nuclear disasters– vulnerability of coastal megacities-lessons from building back better.

TOTAL : 45 PERIODS

**OUTCOMES:**

On completion of the course, the student is expected to be able to

1. Highlight the concepts of hazards and their related physical process
2. Remember the concepts of natural and manmade hazards.
3. Summarizetheadaptationstrategyandmitigationmeasuretocoastalhazards
4. Explain the various laws and policies involved in-institutional coordination of India.
5. Manage the hazards based on case studies and respond in the event of a disaster by appropriate strategies

**Reference Books:**

1. Bryant,E.,"Natural Hazards",Cambridge University Press, NewYork,2006.
2. RajibShawandRRKrishnamurthy,"DisasterManagement:GlobalChallengesLocalSolutions " UniversityPress,2009
3. NationalDisasterManagementAgency–GuidelinesissuedbyNDMAsuchasforearthquakes, tsunamis, cyclones, chemicaldisastersetc.www.ndma.gov.in
4. National Disaster Management Division, Ministry of Home Affairs, GoI.http://www.ndmindia.nic.in/Regularly issued guidelines and training materials especially for disaster management policy ,reconstruction of buildings etc

5. United Nations office for Disaster Risk Reduction www.unisdr.org various publications and guidelines that are constantly updated
6. AsiaDisasterPreparednessCentre.Publicationsspecifictodisasterpreparednessandresponsein Asia.www.adpc.net

| 21CE1955 | COASTAL ZONE MANAGEMENT AND REMOTE SENSING | L | T | P | C |
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OBJECTIVES:

- To be able to "see" the features and components of the coastal zone.
- To assess the various living and non-living resources
- To understand the needs for coastal zone management and to develop an ICM plan. To provide the coastal and oceanographic applications of satellite remote sensing

UNIT I **COASTAL ZONE** **9**

Coastal Zone–Beach Profile–Surf Zone–Off Shore–Coastal Waters– Coastal sediments-Estuaries–Wetlands and Lagoons – Coastal dunes – Coastal Geomorphology.

UNIT II **COASTAL RESOURCES** **9**

Types and functions of coastal and marine sources–Renewable and Non-Renewable resources– LivingmarineresourcesandNonlivingmarineresources–Marineminerals-Placerdeposits– Hydro carbon deposits–Polymetallicnodules.

UNIT III **COASTAL ECOSYSTEM** **9**

Marineecosystem:Mangroves–Seagrass–Seaweeds-Coralreef–Largemarineecosystem-Climateeffectsonlivingmarineresources-Biologicalmonitoringofmarineecosystem-Human impacts on marine ecosystem

UNIT IV **COASTAL REGULATIONS** **9**

Introduction-WhatisICM-DevelopinganICMframework-Principles-Goals-definingboundaries –Coastal Regulation Zones (CRZ) for main land and Islands–Environmental Law and policy.

UNIT V **REMOTE SENSINGIN COASTAL ZONE MANAGEMENT** **9**

Sensors and Plat forms used for coastal application–Mapping of Coral Reefs, Macroalgae, Mangrove and Wetlands – Coastal Land use / Land Cover Mapping – Coastal Regulation Zone Mapping–Case studies

TOTAL : 45 PERIODS

**OUTCOMES:**

On completion of the course, the student is expected to be able to

1. Understand the science and basic of Coastal zone.
2. Assess the living marine resources and non-living marine resources.
3. Learnaboutimportanceofdifferentecosystemavailableincoastalandmarineenvironment.
4. Understand the coastal regulations for main land and islands.
5. Acquire knowledge about various satellites and sensors used for marine and coastal environment.

| 21CE1956 | OCEAN WAVE DYNAMICS | L | T | P | C |
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OBJECTIVES:

- To make the students be aware of ocean wave classification, the mass, momentum and wave energy transformations and wave kinematics that are happening in nature and enable the min the prediction and analysis of the wave data.

UNIT I **CONSERVATION EQUATIONSOF FLUID FLOW** **9**

Basic equations – Conservation of mass, moment and Energy - Continuity Equation, Euler's Equation, Newtonian Fluids, Navier-Stokes Equation.

UNIT II **WAVE THEORIES** **9**

Linear wave theory: Governing Equation, Boundary Conditions and solutions, Dispersion relation, Constancy of wave period. Introduction to non-linear wave theories - Stokes, Cnoidal and Solitary wave theory.

UNIT III **WAVE KINEMATICS** **9**

Wave celerity, water particle velocities, accelerations, displacements and pressures. Integral properties of waves: Mass flux, Energy and energy flux, Group speed, Momentum and momentum flux.

UNIT IV **WAVE TRANSFORMATIONS** **9**

Shoaling, bottom friction and damping, refraction, reflection and diffraction. Wave Breaking: Type of breaking, Surf similarity parameter. Keulegan-Carpenternumber,UrsellParameter,Scatteringparameter,ReynoldsNumber

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UNIT V **WAVE ANALYSIS** **9**

ShorttermwaveanalysisShorttermwaveHeightDistribution–WaveperiodDistribution-TimeandFrequency domain Analysis of Wave Records-Long term wave analysis– Gum bel Distribution Wei bull Distribution- Statistics analysis of grouped wave data.

TOTAL : 45 PERIODS

**OUTCOMES:**

On completion of the course, the student is expected to be able to

1. Understand the concept of mass, momentum and wave energy transformations
2. Classify the linear and nonlinear wave theories including the Stokes theory, solitary and Cnoidal wave theories.
3. Explain the wave kinematics and its properties.
4. Understand the principles of wave transformation.
5. Analyze of the long term and short term waves

**Reference Books:**


1. Sarpkaya,T.andIsaacson,M.,MechanicsofWaveForcesonOffshoreStructures,VanNostrandReinholdCo., New York,1981
2. Dean,R.G.andDalrymple,R.A.,WaterwavemechanicsforEngineersandScientists,Prentice-Hall,Inc.,EnglewoodCliffs,New Jersey,1994
3. ,A.T.,EstuaryandCoastlineHydrodynamics,McGraw-HillBookCompany,inc.,NewYork,1978
4. CoastalEngineeringManualVolumeIandII,CoastalEngineeringResearchCentre,Dept, of the Army,US Army Corps of Engineers, Washington DC, 2006

## VERTICAL IX: DIVERSIFIED COURSES

| 21CE1957 | STEEL CONCRETE COMPOSITE STRUCTURES | L | T | P | C |
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**OBJECTIVES:**

- To develop an understanding of the effect composite action and assess governing limit states for composite elements.

**UNIT I INTRODUCTION TO COMPOSITE ACTION 9**

Introduction to steel - concrete composite construction – codes – composite design – shear connectors – types of shear connectors – degrees of shear connections – partial and full shear connections.

**UNIT II DESIGN OF COMPOSITE BEAM 9**

Introduce composite beams, including shear studs – Determine the location of a beam's neutral axis/axes depending on the level of composite action. Calculate shear stud strength and understand strength modifiers - deflection of composite beams.

**UNIT III DESIGN OF COMPOSITE COLUMN 9**

Types of Composite columns – design of encased columns – design of in-filled columns – axial, uni- axial and bi-axially loaded columns.

**UNIT IV DESIGN OF COMPOSITE SLAB 9**

Introduction – Composite slabs – profiled sheeting – sheeting parallel to span – sheeting perpendicular to span.

**UNIT V CASE STUDIES 9**

Case studies on steel concrete composite construction in buildings - seismic behavior of composite structures

TOTAL : 45 PERIODS

**OUTCOMES:**

At the End of the Course, Learners will be able to:

1. Describe the effect of composite action has on structural component behavior.
2. Describe and assess governing limit states for composite beam
3. Describe and assess governing limit states for composite slab.
4. Describe and assess governing limit states for composite column.
5. Study and evaluate the case studies related to steel concrete composite constructions of buildings.

**TEXT BOOKS:**


1. Johnson R.P., "Composite Structures of Steel and Concrete Beams, Slabs, Columns and Frames for Buildings", Vol .I, Fourth 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, 2000.


**Reference Books:**


1. Owens.G.W and Knowles.P, "Steel Designers Manual", Seventh Edition, Steel ConcreteInstitute(UK), Oxford Blackwell Scientific Publications, 2011.
2. Teaching resource for, "Structural Steel Design," Volume 2 of 3, Institute for SteelDevelopment and Growth (INSDAG), 2002.
3. Narayanan R, "Composite steel structures – Advances, design and construction",Elsevier,Applied science, UK, 1987.

| 21CE1958 | FINANCE FOR ENGINEERS | L | T | P | C |
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**OBJECTIVES:**

- To study the concepts of Finance such as fundamentals of management of accounting, Time value of money, comparing alternatives proposals, evaluating alternative investments and management of funds.

**UNIT I FUNDAMENTALS OF MANAGEMENT ACCOUNTING 9**

Basics of accounting - Management accounting, Financial accounting principles- basic concepts, Financial statements – accounting ratios - funds flow statement – cash flow statement.

**UNIT II TIME VALUE OF MONEY 9**

Time Value of Money – Present Value – Future Value – Single amount - Annuity – Cost of Capital – Cost of Debt, Preference, Equity – Proportions- Cost of Capital Calculation – Financial Institutions Considerations.

**UNIT III COMPARING ALTERNATIVES PROPOSALS 9**

Comparing alternatives- NPV – BCR – IRR – ARR – Urgency – Pay Back Period and Break Even Analysis – Assessment of Various Methods – Indian Practice of Investment Appraisal – International Practice of Appraisal

**UNIT IV EVALUATING ALTERNATIVE INVESTMENTS 9**

Real Estate - Investment Property, Equipment Replace Analysis, Depreciation – Tax before and after depreciation – GST– Input Tax Credit (ITC) – Assessment and Administration of GST– Inflation -Practical knowledge of risk and tax management.

**UNIT V FUNDS MANAGEMENT 9**

Project Finance – Sources of finance - Long-term and short -term finance, Working Capital Management, Inventory valuation, Mortgage Financing - International financial management- foreign currency management - Applications of valuation concepts to real- world cases & examples.

TOTAL : 45 PERIODS

**OUT COMES:**

On completion of the course, the student is expected to be able to

1. Describe the basic principles of accounting
2. Assess the value of money
3. Evaluate alternate proposals
4. Evaluate alternative investments
5. Select best source of finance for a project

**Reference Books:**

1. Prasanna Chandra, Projects – Planning, Analysis, Selection, Implementation Review,McGraw Hill Publishing Company Ltd., New Delhi. 2006.
2. Blank, L.T., and Tarquin,a.J Engineering Economy,4th Edn. Mc-Graw Hill Book Co., 1988
3. Collier C and GlaGola C Engineering Economics & Cost Analysis, 3nd Edn. Addison WesleyEducation Publishers.,1998.
4. Patel, B M Project management- strategic Financial Planning, Evaluation and Control, VikasPublishing House Pvt. Ltd. New Delhi, 2000
5. Steinand noer, H.M. Engineering Economic principles, 2nd Edn. McGrawHill Book, 1996

| 21CE1959 | EARTH AND ROCK FILL DAMS | L | T | P | C |
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**OBJECTIVES:**

- Students are expected to learn reasons for failure and damages of embankments and slopes, various methods of analysis of slopes and remedial techniques to protect the slopes.

**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 : 45 PERIODS

**OUT COMES:**

On completion of the course, the student is expected to be able to

1. Assess the causes of failure and damage of embankments and slopes.
2. Apply the knowledge of engineering and analyse the stability of slopesfor
3. Various seepage conditions and applies the concept in the design ofearth and rock fill dams.
4. Apply the knowledge of engineering and assess the stability of damagainst hydraulic fracturing and suggest suitable remedial measure.
5. Understand the nature of failures and damages in earth and rock filldams and apply the concept in field to avoid distress.CO5 Recommend suitable remedial measures to protect the slopes and implement quality control and monitor its performance

**Reference Books:**


1. Rowe, R.K., Geotechnical and Geo environmental EngineeringHandbook, Kulwer AcademicPublishers, 2001.
2. Anderson, M.G., and Richards, K.S., Slope Stability, John Wiley, 1987.
3. Sherard, J.L., Woodward, R.J., Gizienski, R.J. and Clevenger, W.A.,Earth and Earth rock dam,John Wiley, 1963.
4. Chowdhury, D.F., Slope analysis, Prentice Hall, 1988.
5. McCarthy, D.F., Essentials of Soil Mechanics and Foundations: BasicGeotechnics, SixthEdition, Prentice Hall, 2002.
6. Bramhead, E.N., The Stability of Slopes, Blacky Academic andProfessionals Publications,Glasgow, 1986.
7. Chandhar, R.J., Engineering Developments and Applications, ThomasTelford, 1991
8. Koerner, R.M. Designing with Geosynthetics, Third Edition, PrenticeHall, 1997.
9. Jun-Jie Wang, Hydraulic Fracturing in Earth-rock Fill Dams, JohnWiley & Sons, 2014.

| 21CE1960 | RAINWATER HARVESTING | L | T | P | C |
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**OBJECTIVES:**

- To impart knowledge and skills relevant to water conservation and management towards achieving the sustainability in water resources and relate the engineering principles and practices in estimation of runoff, storage, recharge into the ground and maintain the system through the best management practices followed around the world

**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 wellhydraulics - 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 - Checkdam - 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 : 45 PERIODS

**OUT COMES:**

On completion of the course, the student is expected to be able to

1 Understand the need and importance of water conservation through global and Indianpracticesof rainwater harvesting
2. Understand and apply the concepts of hydrology and groundwater in the estimation ofrunoff and recharge potentials
3. Understand the various types of rainwater harvesting methods and apply it on the field
4. Design the various RWH structures to harvest the rainwater in surface and

subsurface

5. Explain the difficulties of RWH, evaluation methods and maintenance through various case studies.

**TEXT BOOKS**


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


**REFERENCES:**


1. Proceedings of UNHABITAT Blue water series "Rainwater harvesting and utilization", Book 2beneficiaries and capacity builders.
2. Rain water Harvesting Techniques to Augment Ground Water: Ministry of Water ResourcesCentral Ground Water Board Faridabad,2003.
3. Rainwater Harvesting: Indian Railway Institute of Civil Engineering Pune, October 2015.
4. A Manual on "Rainwater Harvesting and Conservation": Government of India, Consultancy Service Organization Central Public Works Department, New Delhi.
5. "A Water Harvesting Manual for Urban Areas" issued by Centre for Science and Environment.
6. Traditional Water Harvesting Systems of India" C.P.R. Environmental Education Centre, Chennai,India (2004).
7. Empowering Village Communities for A Sustainable Water Future - A Resource Book for Jaldoots, 2019, Prepared by Central Ground Water Board, Dept. of Water Resources, River Development and Ganga Rejuvenation, Ministry of Jal Shakti, Govt. of India and MARVI – Managing Aquifer Recharge and Sustaining Ground water Use through Village-level Intervention.
8. Handbook on rainwater harvesting storage options, Ministry of Water & Environment, Uganda

| 21CE1961 | TRANSPORT AND ENVIRONMENT | L | T | P | C |
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**OBJECTIVES:**

- The objective of this course is to create an awareness / overview of the impact of Transportation Projects on the environment and society.

**UNIT I INTRODUCTION 9**

Environmental Inventory, Environmental Assessment, Environmental Impact Assessment (EIA), Environmental Impact of Transportation Projects, Need for EIA, EIA Guidelines for Transportation Project, Historical Development.

**UNIT II METHODOLOGIES 9**

Elements of EIA – Screening and Scoping – Methods of Impact Analysis – Applications –Appropriate methodology.

**UNIT III ENVIRONMENTAL IMPACT, PREDICTION AND ASSESSMENT 9**

Prediction and Assessment of Impact of Transportation Project at various stages on water, air, noise, land acquisition and resettlement, Socio economic impact, indigenous people, aesthetics, health and safety, energy studies, traffic impact studies, IRC guidelines.

**UNIT IV ENVIRONMENTAL MITIGATION AND MANAGEMENT PLAN 9**

Mitigation of the impact on Natural and Man-made Environment, Health, Water, Land, Noise, Air, Public participation, Environmental Management Plan, Energy Conservation, Methods to reduce Global Warming.

**UNIT V EIA CASE STUDIES 9**

EIA Case Studies on Highway, Railway - EIA Case Studies on Transit Oriented Development (TOD),Compact Cities, Non-Motorized Transport (NMT)

TOTAL : 45 PERIODS

**OUT COMES:**

On completion of the course, the student is expected to be able to

1. Understand the basic concepts of Environmental Impact of Assessment
2. Apply various methods of analyzing environmental Impact Analysis.
3. Gain knowledge on Stage Wise Assessment and Prediction of impact of transportation projects
4. Adopt environmental management plan and their impact on earth.
5. Reviewing various case studies on environmental impact assessment of transport projects.

**TEXT BOOKS**


1. Canter, L.R., Environmental Impact Assessment, McGraw Hill, New Delhi, 1996.
2. Indian Road Congress (IRC), Environmental Impact of Highway Projects, IRC, Delhi, 1998.
3. EIA Guidance Manual- Highway- MOEF & Govt of India, 2010
4. P. Meenakshi, Elements of Environmental Science and Engineering, Prentice Hall of India,New Delhi, 2006
5. Thirumurthy A.M., Introduction to Environmental Science and Management, Shroff Publishers, Bomba


**REFERENCES:**


1. John G.Rau and David, C.Hooten, Environmental Impact Analysis

| 21CE1962 | ENVIRONMENTAL QUALITY MONITORING | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**OBJECTIVES:**

- To educate the students on the sample collection and various instrumental methods of monitoring the quality of air, water and solid waste.

**UNIT I MONITORING AND CHARACRATERIZATION OF ENVIRONMENT 9**

General approach to environmental analysis, Choice of Lab.Vs. Field analysis, Environmental monitoring-current and future status, Lab. Standards, Data quality objectives, statistics in environmental monitoring, Accuracy and precision, detection limit, types of errors, Automated Data acquisition and processing-sensors and transducers , Monitoring Network and real time monitoring

**UNIT II ENVIRONMENTAL SAMPLING 9**

Location, planning, sampling equipment's for water, solids and air, sample storage for physical and chemical contaminants ,types of sampling, representative samples, sample preparation techniques- Solvent Extraction, SPE, Head space, Purge and trap and SPME

**UNIT III WATER ANALYSIS 9**

Techniques for analysis of major ions-UV-visible Spectrophotometer, Flame photometer, AAS, ICP(AES and MS), Trace organic pollutants (PCB, dioxins, pecticides) GC and HPLC (Columns Detectors and Application)

**UNIT IV ATMOSPHEREIC ANALYSIS 9**

Ambient air and flue gas, Gaseous pollutants-Determination of time weighted average concentration(Absorption trains, solid adsorbents and differential tubes), Direct reading instruments(fluorescence,chemiluminescent,IR and Electrochemical sensors, GC-MS for trace organics, Particulate sampling methods- High volume sampler, personal sampler, PM 10 and 2.5, Metals Direct(XRF) and dissolution methods(AAS/AES)

**UNIT V ANALYSIS OF SOIL AND WASTE 9**

Problem in analysis of soil and Waste -sampling, pretreatment -extraction and clean up, New extraction techniques, Automated soxhlet and solvent extraction, microwave digestion and sonication,SCF($CO_2$), Analysis for trace pollutants, Analysis of leachate.

TOTAL : 45 PERIODS

**OUT COMES:**

On completion of the course, the student is expected to be able to

1. Understand the basics of environmental monitoring
2. Able to select appropriate sampling protocol for chemical analysis
3. Understand various methods of analysis of pollutants in water
4. Select correct method for toxic pollutants estimation in air
5. Familiar with analysis of land and wastes

**REFERENCES:**

1. Reeve, R.N., “Introduction to Environmental Analysis”, Analytical Techniques in the Sciences, JohnWiley & Sons, Chichester, UK, 2002.
2. Barcelo, D.(editor), “Environmental analysis. Techniques, Applications and Quality Assurance”,Elsevier, The Netherlands, 1996
3. Paul R. Loconto Trace Environmental Quantitative Analysis: Principles, Techniques, and Applications, Marcel Dekker; 2nd Edition , 2005,
4. Janick Artiola, Ian Pepper and Mark Brusseau, Environmental Monitoring And Characterization , Academic Press,2004.

| 21CE1963 | COMPUTATIONAL FLUID DYNAMICS | L | T | P | C |
|---|---|---|---|---|---|
| | | 3 | 0 | 0 | 3 |

**OBJECTIVES:**

The main learning objective of this course is to prepare the students for

- Applying the fundamentals of CFD, and developing case specific governing equations,
- Performing finite difference and finite volume based analysis for steady and transient diffusion problems,
- Implementing various mathematical schemes under finite volume method for convention diffusion.
- Solving complex problems in the field of fluid flow and heat transfer with the support of high speed computers.
- Applying the various discretization methods, solution procedure and the concept of turbulence modelling.

**UNIT I GOVERNING EQUATIONS AND BOUNDARY CONDITIONS 9**

Basics of computational fluid dynamics – Governing equations– Continuity, Momentum and Energy equations – Chemical species transport –Physical boundary conditions – Time-averaged equations for Turbulent Flow – Turbulent–Kinetic Energy Equations – Mathematical behavior of PDEs on CFD - Elliptic, Parabolic and Hyperbolic equations.

**UNIT II FINITE DIFFERENCE AND FINITE VOLUME METHODS FOR DIFFUSION 9**

Derivation of finite difference equations– General Methods for first and second order accuracy – Finite volume formulation for steady and transient diffusion problems –Example problems– Use of Finite Difference and Finite Volume methods

**UNIT III FINITE VOLUME METHOD FOR CONVECTION DIFFUSION 9**

Steady one-dimensional convection and diffusion – Central, upwind differencing schemes, properties of discretization schemes, Hybrid, Power-law, QUICK Schemes, Conservativeness, Boundedness, Transportiveness.

**UNIT IV FLOWFIELD ANALYSIS 9**

Stream function and vorticity, Representation of the pressure gradient term, Staggered grid – Momentum equations, Pressure and Velocity corrections – Pressure Correction equation, SIMPLE algorithm and its variants – PISO Algorithms

**UNIT V TURBULENCE MODELS AND MESH GENERATION 9**

Turbulence models, mixing length model, Two equation (k-Є) models – High and lowReynolds number models, Mesh Generation and refinement Techniques-software tools..

TOTAL : 45 PERIODS

**OUT COMES:**

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

1. Apply the fundamentals of CFD and develop case specific governing equations
2. Perform finite difference and finite volume based analysis for steady and transient diffusion problems
3. Implement various mathematical schemes under finite volume method for convention diffusion
4. Solve complex problems in the field of fluid flow and heat transfer with the support of high speed computers
5. Apply the various discretization methods, solution procedure and the concept of turbulence modelling

**TEXT BOOKS:**


1. Versteeg, H.K. and Malalasekera, W. “An Introduction to Computational Fluid Dynamics: The finite volume Method”, Pearson Education,2014
2. Ghoshdastidar, P.S., “Computer Simulation of flow and heat transfer”, Tata McGraw Hill, 1998


**REFERENCES:**


1. John. F. Wendt, “Computational Fluid Dynamics – An Introduction”, Springer,2013.
2. K.Muralidhar&T.Sundararajan, Computational Fluid Flow and Heat Transfer, Narora Publishing House,1994.
3. Suhas V, Patankar, “Numerical Heat transfer and Fluid flow”, Taylor &