# COURSE INFORMATION SHEET

**Course code: CE 530**
**Course title: Environmental Engineering Laboratory 1**
**Pre-requisite(s):**
**Co- requisite(s):**
**Credits: 2** L: 0 T: 0 P: 4
**Class schedule per week: 4**
**Class: M. Tech**
**Semester / Level: Ist SEMESTER/ LEVEL 5**
**Branch: Environmental Science and Engineering**
**Name of Teacher:**

**Course Objectives**

This course enables the students:

| | |
|---|---|
| A. | To introduce the students about the importance of water and its properties and given standards (K2,K3) |
| B. | To make students aware about the procedure for the analysis of various water quality parameters (K2) |
| C. | To introduce the students how to make water quality assessment report (K2,K3, K5) |
| D. | To make students aware about the required type of treatment to purify a given water sample.(K3, K5) |
| E. | To introduce students about the quality requirements of water in various uses of water for example, industrial purpose and domestic purpose.(K4,K5,K6) |

**Course Outcomes**

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

| | |
|---|---|
| 1. | Understand the importance of water and its quality requirement (K2,K3) |
| 2. | Understand the procedure for analysis of various quality paramenters (K2) |
| 3. | Understand the procedure of making water quality assessment report (K2,K3, K5) |
| 4. | Understand and suggess the the water treatment process for a raw water(K3, K5) |
| 5. | Understand and suggess the water quality requirements for industrial and domestic purposes (K4, K5,K6) |

## Syllabus

1. To determine pH, EC, and Turbidity and T.D.S.of a given water sample.
2. To determine total alkalinity of a given water sample.
3. To determine acidity of a given water sample
4. To determine total hardness of a given water sample
5. To determine dissolved oxygen (DO) of a given water sample
6. To determine B.O.D. of a given water sample
7. To determine C.O.D. of a given water sample
8. To determine the residual chlorine in a given water sample.
9. To determine nitrates of a given water sample
10. To determine phosphates of a given water sample

11. To determine Fluoride in a given water sample
12. To determine Iron of a given water sample
13. To determine the bacteriological quality of a given water sample.

**Text books:**

- Standard methods for the examination of water and wastewater published by APHA
- Water supply Engineering, by Santhosh Kumar Garg, Khanna publishers

**Gaps in the syllabus (to meet Industry/Profession requirements)**
**POs met through Gaps in the Syllabus**
**Topics beyond syllabus/Advanced topics/Design**

**POs met through Topics beyond syllabus/Advanced topics/Design**

| **Course Delivery methods** | |
|---|---|
| Lecture by use of boards/LCD projectors/OHP projectors | ✓ |
| Tutorials/Assignments | ✓ |
| Seminars | |
| Mini projects/Projects | |
| Laboratory experiments/teaching aids | ✓ |
| Industrial/guest lectures | |
| Industrial visits/in-plant training | ✓ |
| Self- learning such as use of NPTEL materials and internets | ✓ |
| Simulation | |

## Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

**Direct Assessment**

| **Assessment Tool** | **% Contribution during CO Assessment** |
|---|---|
| Progressive Evaluation Marks | 60 |
| EndExamination Marks | 40 |

| **Assessment Components** | **CO1** | **CO2** | **CO3** | **CO4** | **CO5** |
|---|---|---|---|---|---|
| Progressive Evaluation Marks | ✓ | ✓ | ✓ | ✓ | ✓ |
| EndExamination Marks | ✓ | ✓ | ✓ | ✓ | ✓ |

**Indirect Assessment –**

1. Student feedback on teaching quality and teaching methods adopted
2. Student feedback on course syllabus and course outcome

**Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes**

| **Course Outcome** | **Program Outcomes** | | | | | | **Program Specific Outcome** | | |
|---|---|---|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **6** | **1** | **2** | **3** |
| **1** | 3 | 3 | 3 | 3 | 3 | 1 | 3 | 3 | 3 |

| Mapping Between COs and Course Delivery (CD) methods | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | |
| **CD** | **Course Delivery methods** | | | | | | **Course Outcome** | | **Course Delivery Method** | |
| CD1 | Lecture by use of boards/LCD projectors/OHP projectors | | | | | | CO1 | | CD1, CD2, CD5, CD8 | |
| CD2 | Tutorials/Assignments | | | | | | CO2 | | CD1, CD2, CD5, CD7,CD8 | |
| CD3 | Seminars | | | | | | CO3 | | CD1, CD2, CD5, CD8, | |
| CD4 | Mini projects/Projects | | | | | | CO4 | | CD1, CD2, CD5, CD7,CD8, | |
| CD5 | Laboratory experiments/teaching aids | | | | | | CO5 | | CD1, CD2, CD5, CD8 | |
| CD6 | Industrial/guest lectures | | | | | | | | | |
| CD7 | Industrial visits/in-plant training | | | | | | | | | |
| CD8 | Self- learning such as use of NPTEL materials and internets | | | | | | | | | |
| CD9 | Simulation | | | | | | | | | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **2** | 3 | 3 | 3 | 3 | 3 | 1 | 3 | 3 | 3 |
| **3** | 3 | 3 | 3 | 3 | 3 | 1 | 3 | 3 | 3 |
| **4** | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 3 |
| **5** | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 3 |

# COURSE INFORMATION SHEET

**Course code: CE 531**
**Course title: ECOLOGY AND MICROBIOLOGY LAB**
**Pre-requisite(s):**
**Co- requisite(s):**
**Credits: 2** L: 0 T: 0 P: 4
**Class schedule per week: 4**
**Class: M. Tech**
**Semester / Level: 1ST SEMESTER/ LEVEL 5**
**Branch: Environmental Science and Engineering**
**Name of Teacher:**

**Course Objectives**

This course enables the students:

| | |
|---|---|
| A. | To analyse the community structure of vegetation patch for biodiversity study. (K4) |
| B. | To understand the concept of productivity in aquatic ecosystem. (K4) |
| C. | To learn the techniques related to environmental microbiology. (K2) |
| D. | To isolate and employ bacterial strains for environmental pollutant degradation study. (K2) |

**Course Outcomes**

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

| | |
|---|---|
| 1. | Design and enumerate floral diversity of an ecosystem. (K6) |
| 2. | Analyse the state of an aquatic ecosystem according to its productivity rate. (K5) |
| 3. | Isolate and culture bacterial strains from the environmental samples. (K4) |
| 4. | Examine the water quality in terms of biological water pollutants (K4) |
| 5. | To design and implement bacterial degradation studies in lab scale against environmental pollutants. (K5) |

## Syllabus

1. Vegetation community structure study: Determination of minimum size of a quadrat.
2. Vegetation community structure study: Determination of minimum numbers of a quadrat.
3. To determine the frequency, abundance and dominance of plant species in a vegetation community.
4. Aquatic productivity estimation through Light and Dark Bottle method
5. Microbiological Media preparation and sterilization
6. Isolation of bacterial strain from environmental samples (air, water and soil)
7. Total Coliform estimation through membrane- filter technique
8. Total coliform estimation through MPN
9. Gram staining technique
10. Handling of liquid cultures and monitoring microbial growth phases via spectrophotometry

**Text books:**

1. Practical Ecology by Rao K.S, K.S. Rao, Anmol Publications
2. Practical field Ecology by Wheater C. Philip, Publisher: John Wiley and Sons Ltd
3. Practical Microbiology by R.C. Dubey and Maheswari D.K. (S.Chand Publication)
4. Microbiology A laboratory Manual by Cappuccino Sherman (Pearson Education Publication)

**Gaps in the syllabus (to meet Industry/Profession requirements)**
**POs met through Gaps in the Syllabus**
**Topics beyond syllabus/Advanced topics/Design**

**POs met through Topics beyond syllabus/Advanced topics/Design**

| **Course Delivery methods** | |
|---|---|
| Lecture by use of boards/LCD projectors/OHP projectors | ✓ |
| Tutorials/Assignments | |
| Seminars | |
| Mini projects/Projects | |
| Laboratory experiments/teaching aids | ✓ |
| Industrial/guest lectures | ✓ |
| Industrial visits/in-plant training | ✓ |
| Self- learning such as use of NPTEL materials and internets | ✓ |
| Simulation | |

## Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

**Direct Assessment**

| **Assessment Tool** | **% Contribution during CO Assessment** |
|---|---|
| Progressive Evaluation Marks | 60 |
| End Examination Marks | 40 |

| **Assessment Components** | **CO1** | **CO2** | **CO3** | **CO4** | **CO5** |
|---|---|---|---|---|---|
| Progressive Evaluation Marks | ✓ | ✓ | ✓ | ✓ | ✓ |
| End Examination Marks | ✓ | ✓ | ✓ | ✓ | ✓ |

**Indirect Assessment –**

1. Student feedback on teaching quality and teaching methods adopted
2. Student feedback on course syllabus and course outcome

| Course Outcome | Program Outcomes | | | | | |
|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **6** |
| **1** | 3 | 3 | 2 | 1 | 2 | 1 |
| **2** | 3 | 2 | 2 | 3 | 2 | 1 |
| **3** | 3 | 3 | 3 | 3 | 2 | 2 |
| **4** | 3 | 2 | 3 | 2 | 2 | 2 |
| **5** | 3 | 2 | 2 | 2 | 2 | 1 |

| **Mapping Between COs and Course Delivery (CD) methods** | | | | |
|---|---|---|---|---|
| | | | | |
| **CD** | **Course Delivery methods** | | **Course Outcome** | **Course Delivery Method** |
| CD1 | Lecture by use of boards/LCD projectors/OHP projectors | | CO1 | CD1, CD5, CD7, CD8, CD9 |
| CD2 | Tutorials/Assignments | | CO2 | CD1, CD5, CD7, CD8, CD9 |
| CD3 | Seminars | | CO3 | CD1, CD5, CD7, CD8, CD9 |
| CD4 | Mini projects/Projects | | CO4 | CD1, CD5, CD8, CD9 |
| CD5 | Laboratory experiments/teaching aids | | CO5 | CD1, CD5, CD8 |
| CD6 | Industrial/guest lectures | | | |
| CD7 | Industrial visits/in-plant training | | | |
| CD8 | Self- learning such as use of NPTEL materials and internets | | | |
| CD9 | Simulation | | | |

# COURSE INFORMATION SHEET

**Course code: CE 535**
**Course title: ENVIRONMENTAL ENGINEERING LABORATORY-II**
**Pre-requisite(s):**
**Co- requisite(s):**
**Credits: 2** L: 0 T: 0 P: 4
**Class schedule per week: 4**
**Class: M. Tech**
**Semester / Level: 2ND SEMESTER/ LEVEL 5**
**Branch: Environmental Science and Engineering**
**Name of Teacher:**

**Course Objectives**

This course enables the students:

| | |
|---|---|
| A. | To monitor and analyse the air pollution level of the ambient air. (K4) |
| B. | To select the suitable plant species for green belt development. (K4) |
| C. | To determine some important soil properties and assess its effect on environmental quality. (K6) |
| D. | To demonstrate some solar powered instrument as a renewable energy source. (K2) |

**Course Outcomes**

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

| | |
|---|---|
| 1. | Design and implement ambient air quality monitoring plan. (K6) |
| 2. | Interpret the air quality data and evaluate the air pollution status. (K5) |
| 3. | Recommend suitable plant species with dust capturing capacity. (K5) |
| 4. | Examine some of the soil physico-chemical properties. (K4) |
| 5. | To understand the use of some of the solar powered instruments. (K2) |

## Syllabus

11. Monitoring and analysis of $PM_{10}$ and $PM_{2.5}$ in the ambient air.
12. Sampling and analysis of NOx by chemiluminescence method.
13. Sampling and analysis of $CO_2$ and CO by NDIR method.
14. Sampling and analysis of sulphur dioxide in ambient air (Improved West and Gaeke method)
15. Sampling and analysis of Lead, Nickel and Arsenic in ambient air.
16. Estimation of dust retention capacity of leaves of various species.
17. Determination of particle size distribution in fine aggregates.
18. To determine the soil particle size distribution by hydrometer analysis.
19. To determine the moisture content of soil by gravimetric method.
20. Introduction to solar lab and study various solar powered equipment.

**Text books:**


1. Soil Testing for Engineers- Lambe T.W., Wiley Eastern Ltd., New Delhi. 5. Manual of
2. Soil Laboratory Testing- Head K.H., (1986)- Vol. I, II, III, Princeton Press, London


Reference books:

1. Guidelines for the Measurement of Ambient Air Pollutants, CPCB ,2013.

**Gaps in the syllabus (to meet Industry/Profession requirements)**
**POs met through Gaps in the Syllabus**
**Topics beyond syllabus/Advanced topics/Design**

**POs met through Topics beyond syllabus/Advanced topics/Design**

| **Course Delivery methods** | |
|---|---|
| Lecture by use of boards/LCD projectors/OHP projectors | ✓ |
| Tutorials/Assignments | |
| Seminars | |
| Mini projects/Projects | |
| Laboratory experiments/teaching aids | ✓ |
| Industrial/guest lectures | |
| Industrial visits/in-plant training | ✓ |
| Self- learning such as use of NPTEL materials and internets | ✓ |
| Simulation | |

## Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

**Direct Assessment**

| Assessment Tool | % Contribution during CO Assessment |
|---|---|
| Progressive Evaluation Marks | 60 |
| End Examination Marks | 40 |

| Assessment Components | CO1 | CO2 | CO3 | CO4 | CO5 |
|---|---|---|---|---|---|
| Progressive Evaluation Marks | ✓ | ✓ | ✓ | ✓ | ✓ |
| End Examination Marks | ✓ | ✓ | ✓ | ✓ | ✓ |

**Indirect Assessment –**

1. Student feedback on teaching quality and teaching methods adopted
2. Student feedback on course syllabus and course outcome

**Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes**

| Course Outcome | Program Outcomes | | | | | |
|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **6** |
| **1** | 3 | 2 | 3 | 2 | 3 | 1 |
| **2** | 3 | 3 | 3 | 3 | 3 | 2 |
| **3** | 3 | 3 | 3 | 3 | 3 | 2 |
| **4** | 3 | 2 | 3 | 2 | 2 | 2 |
| **5** | 2 | 2 | 1 | 2 | 2 | 1 |

| **Mapping Between COs and Course Delivery (CD) methods** | | | | |
|---|---|---|---|---|
| | | | | |
| **CD** | **Course Delivery methods** | | **Course Outcome** | **Course Delivery Method** |
| CD1 | Lecture by use of boards/LCD projectors/OHP projectors | | CO1 | CD1, CD5, CD7, CD8, CD9 |
| CD2 | Tutorials/Assignments | | CO2 | CD1, CD5, CD8, CD9 |
| CD3 | Seminars | | CO3 | CD1, CD5, CD7, CD8, CD9 |
| CD4 | Mini projects/Projects | | CO4 | CD1, CD5, CD8, CD9 |
| CD5 | Laboratory experiments/teaching aids | | CO5 | CD1, CD5, CD8 |
| CD6 | Industrial/guest lectures | | | |
| CD7 | Industrial visits/in-plant training | | | |
| CD8 | Self- learning such as use of NPTEL materials and internets | | | |
| CD9 | Simulation | | | |

# COURSE INFORMATION SHEET

**Course code: CE 536**
**Course title: DESIGN OF WATER AND WASTEWATER SYSTEM**
**Pre-requisite(s):**
**Co- requisite(s):**
**Credits: 2** L: 0 T: 0 P: 4
**Class schedule per week: 4**
**Class: M. Tech**
**Semester / Level: 2ND SEMESTER/ LEVEL 5**
**Branch: CIVIL & ENVIRONMENTAL ENGINEERING**
**Name of Teacher:**

**Course Objectives**

This course enables the students:

| | |
|---|---|
| A. | To introduce the students about the basic concepts of water supply system(K2,K3) |
| B. | To make students aware about design criteria's for water supply systems(K6) |
| C. | To introduce the students about the basic concepts of wastewater treatment system (K2,K3) |
| D. | To make students aware about design criteria's for wastewater treatment systems(K6) |
| E. | To introduce softwares for water and waste water treatment designing(K5,K6) |

**Course Outcomes**

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

| | |
|---|---|
| 1. | Understand the designing concepts of water supply (K2,K3) |
| 2. | Design water supply systems(K6) |
| 3. | Understand the designing criteria and concepts of waste water treatment systems (K2,K6) |
| 4. | Design wastewater treatment systems(k6) |
| 5. | Design water and waste water treatment systems using softwares (K5,K6) |

## Syllabus

14. To Identify and understand the basic design criteria of water supply systems.
15. To design a sedimentation tank in water supply system
16. To design a aeration tank in water supply system
17. To design a chlorination dosage for water supply system
18. To design filtration units for water supply system
19. To design a storm-water management system
20. To design a water distribution network system using a software
21. To Design a primary treatment facility for WWT.
22. To Design a secondary treatment facility for WWT.
23. To Design a tertiary treatment facility for WWT.
24. To design a decentralised wastewater treatment system
25. An introduction to softwares on Wastewater treatment design facilities.

**Text books:**

- Peavy H S., Rowe DR, Tchobanoglous G., Environmental Engineering, McGraw Hill International.
- Bhave PR, Gupta R, Analysis of Water Distribution Network, Narosa Publishing House, New Delhi
- Qasim SR, Motley EM, Zhu G., Water works engineering0Plaanning, design and Operation. Prentice hall.
- CPHEEO manual on water supply and treatment, 2nd ed. MoUD. New Delhi

**Gaps in the syllabus (to meet Industry/Profession requirements)**
**POs met through Gaps in the Syllabus**
**Topics beyond syllabus/Advanced topics/Design**

**POs met through Topics beyond syllabus/Advanced topics/Design**

| **Course Delivery methods** | |
|---|---|
| Lecture by use of boards/LCD projectors/OHP projectors | ✓ |
| Tutorials/Assignments | ✓ |
| Seminars | |
| Mini projects/Projects | ✓ |
| Laboratory experiments/teaching aids | ✓ |
| Industrial/guest lectures | |
| Industrial visits/in-plant training | ✓ |
| Self- learning such as use of NPTEL materials and internets | ✓ |
| Simulation | |

## Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

**Direct Assessment**

| **Assessment Tool** | **% Contribution during CO Assessment** |
|---|---|
| Progressive Evaluation Marks | 60 |
| End Examination Marks | 40 |

| **Assessment Components** | **CO1** | **CO2** | **CO3** | **CO4** | **CO5** |
|---|---|---|---|---|---|
| Progressive Evaluation Marks | ✓ | ✓ | ✓ | ✓ | ✓ |
| EndExamination Marks | ✓ | ✓ | ✓ | ✓ | ✓ |

**Indirect Assessment –**

1. Student feedback on teaching quality and teaching methods adopted
2. Student feedback on course syllabus and course outcome

**Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes**

| Course Outcome | Program Outcomes | | | | | |
|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **6** |
| **1** | 1 | 2 | 3 | 2 | 3 | 1 |
| **2** | 2 | 2 | 3 | 3 | 3 | 2 |
| **3** | 1 | 2 | 3 | 2 | 3 | 1 |
| **4** | 2 | 2 | 3 | 3 | 3 | 2 |
| **5** | 2 | 2 | 3 | 2 | 3 | 2 |

| **Mapping Between COs and Course Delivery (CD) methods** | | | | |
|---|---|---|---|---|
| | | | | |
| **CD** | **Course Delivery methods** | | **Course Outcome** | **Course Delivery Method** |
| CD1 | Lecture by use of boards/LCD projectors/OHP projectors | | CO1 | CD1, CD2, CD5, CD8 |
| CD2 | Tutorials/Assignments | | CO2 | CD1, CD2, CD5, CD7,CD8 |
| CD3 | Seminars | | CO3 | CD1, CD2, CD5, CD8, |
| CD4 | Mini projects/Projects | | CO4 | CD1, CD2, CD5, CD7,CD8, |
| CD5 | Laboratory experiments/teaching aids | | CO5 | CD1, CD2, CD8,Cd9 |
| CD6 | Industrial/guest lectures | | | |
| CD7 | Industrial visits/in-plant training | | | |
| CD8 | Self- learning such as use of NPTEL materials and internets | | | |
| CD9 | Simulation | | | |

# COURSE INFORMATION SHEET

**Course code: CE538**
**Course title: Environmental System Engineering**
**Pre-requisite(s):**
**Co- requisite(s):**
**Credits: 2** L: T: P:4
**Class schedule per week: 4**
**Class: M. Tech**
**Semester / Level: III/VI**
**Branch: Environmental Science & Eng.**
**Name of Teacher:**

**Course Objectives**

This course enables the students:

| | |
|---|---|
| A. | To Identify the impact of industrial activities on the environment and apply the knowledge of environmental system engineering in the choice of cost-effective remediation strategies (K3, K5) |
| B. | To identify the system boundary of the existing problem (K3, K4) |
| C. | To address the critical environmental issues with optimization techniques for the useful utilization of land and mineral resources, wastewater treatment, and solid waste management and disposal. (K3, K5) |
| D. | To understand the importance of time by solving 'optimization over time' problems (K3, K4) |
| .E | To identify the contemporary issues, design, formulate and solve the problem. (K5, K6) |

**Course Outcomes**
After the completion of this course, students will be able to:

| | |
|---|---|
| 1. | apply the knowledge of science, mathematics and engineering and work with multidisciplinary team (K3, K4) |
| 2. | An ability to analyze, interpret data and use appropriate optimization techniques (K3, K6) |
| 3. | An ability to design & formulate a system and its components as per the desired need and solve engineering problems (K5, K6) |
| 4. | An understanding of professional, ethical responsibility and knowledge of contemporary issues (K4, K5) |
| 5 | An ability to minimize the environmental impact and opt for cost-effective remediation techniques (K4, K5) |

## Syllabus

1. problem formulation, model construction and deriving solution from models. (Graphical methods)
2. Simplex and Dual Simplex Method. Limitations of LPP. Sensitivity analysis
3. LPP (Artificial Variable: M method and 2 phase)
4. Transportation models
5. Coal mine transportation problem
6. Application of ILPM (municipal solid waste management)

7. air quality management
8. Agricultural non-point source pollution: pesticide management problems
9. Lagrange's multipliers: Unconstrained and constrained optimization
10. Sequential search algorithms (Box algorithm)
11. Separable and integer programming (multi-objective planning)
12. Dynamic programming models (land use planning)
13. Optimization over time (Wildlife habitat)

**Text books:**

1. Environmental Systems Optimization – D.A.Haith , 1982, Wiley Sons, NY.
2. Operations Research: An Introduction - Hamdy A. Taha, Prentice Hall Pub.
3. Environmental System Engineering & Economics – Robert Wills & Brad A. Finney, Kluwer Academic Pub.
4. Techniques for Environmental System Analysis - R.H.Pantell Wiley, NY, 2001.

**Reference books:**

1. Operation Research: theory & applications – J. K. Sharma,

**Gaps in the syllabus (to meet Industry/Profession requirements)**
**POs met through Gaps in the Syllabus**
**Topics beyond syllabus/Advanced topics/Design**

**POs met through Topics beyond syllabus/Advanced topics/Design**

| **Course Delivery methods** | |
|---|---|
| Lecture by use of boards/LCD projectors/OHP projectors | ✓ |
| Tutorials/Assignments | ✓ |
| Seminars | |
| Mini projects/Projects | |
| Laboratory experiments/teaching aids | |
| Industrial/guest lectures | |
| Industrial visits/in-plant training | |
| Self- learning such as use of NPTEL materials and internets | ✓ |
| Simulation | |

## Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

## Direct Assessment

| **Assessment Tool** | **% Contribution during CO Assessment** |
|---|---|
| Progressive Evaluation Marks | 60 |
| End Examination Marks | 40 |

| **Assessment Compoents** | **CO1** | **CO2** | **CO3** | **CO4** | **CO5** |
|---|---|---|---|---|---|
| Progressive Evaluation Marks | ✓ | ✓ | ✓ | ✓ | ✓ |
| End Examination Marks | ✓ | ✓ | ✓ | ✓ | ✓ |

**Indirect Assessment –**

1. Student Feedback on Faculty
2. Student Feedback on Course Outcome

## Mapping between Objectives and Outcomes

**Mapping of Course Outcomes onto Program Outcomes**

| Course Outcome | Program Outcomes | | | | | | Program Specific Outcome | | |
|---|---|---|---|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** | **6** | **1** | **2** | **3** |
| **1** | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 3 | 3 |
| **2** | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 3 | 3 |
| **3** | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 3 | 3 |
| **4** | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 3 | 3 |
| **5** | 3 | 3 | 3 | 2 | 2 | 3 | 3 | 3 | 3 |

| Mapping Between COs and Course Delivery (CD) methods | | | | |
|---|---|---|---|---|
| | | | | |
| **CD** | **Course Delivery methods** | | **Course Outcome** | **Course Delivery Method** |
| CD1 | Lecture by use of boards/LCD projectors/OHP projectors | | CO1 | CD1, CD2, CD8 |
| CD2 | Tutorials/Assignments | | CO2 | CD1, CD2, CD8 |
| CD3 | Seminars | | CO3 | CD1, CD2, CD8 |
| CD4 | Mini projects/Projects | | CO4 | CD1, CD2, CD8 |
| CD5 | Laboratory experiments/teaching aids | | CO5 | CD1, CD2, CD8 |
| CD6 | Industrial/guest lectures | | | |
| CD7 | Industrial visits/in-plant training | | | |
| CD8 | Self- learning such as use of NPTEL materials and internets | | | |
| CD9 | Simulation | | | |